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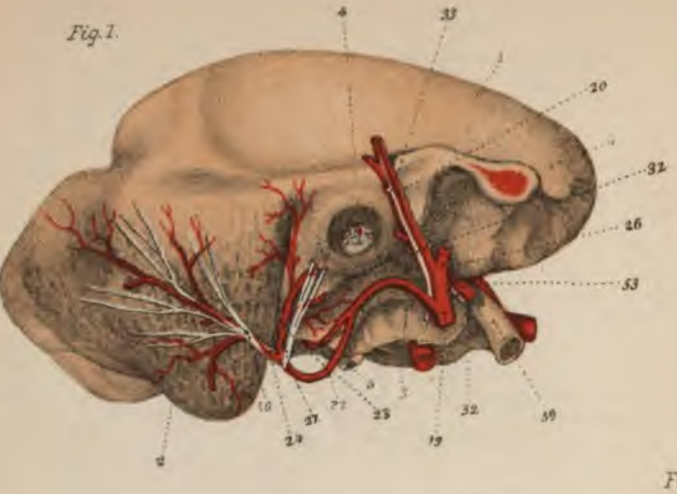

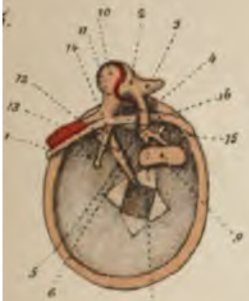

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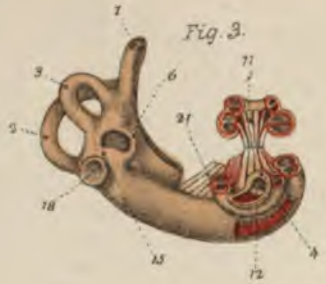

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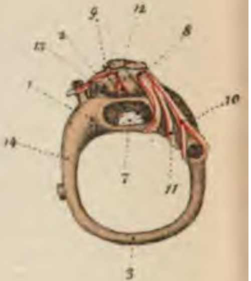

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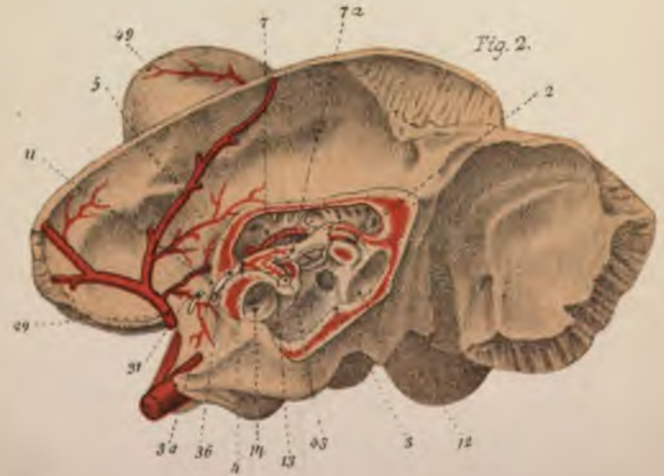

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DESCRIPTION OF PLATE.

Figure I.—Temporal Bone (Front View).

1. Squamous portion of temporal bone.
2. Mastoid portion of temporal bone.
3. Petrous portion of temporal bone.
4. External auditory canal.
5. Glasserian fissure.
6. Zygomatic process.
8. Styloid process.
19. External carotid artery furnishing
20. Superficial temporal artery.
22. Stylo-mastoid artery.
23. Posterior auricular artery.
24. Branches to mastoid process.
26. Origin of internal maxillary artery.
32. Portion of auriculo-temporal nerve.
33. External auriculo-temporal nerve.
50. Portion of auriculo-occipital nerve.
52. Exit of the chorda tympani nerve.
53. Anterior muscle of malleus.
59. Eustachian tube.

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3. Receptacle for semicircular canals.
3*a*. Vidian nerve.
4. Geniculated ganglion.
5. Branches of auricular artery.
7. Anastomosis of meningeal artery.
7*a*. Anastomosis of auricular artery.
11. Fallopian hiatus.
12. Cavity semicircular canals.
13. Attachment of membrana tympani.
14. Cavity for cochlea.
29. Internal meningeal artery.
31. Nerve of M. Longet.
36. Portion of great petrous nerve.
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49. External ear (anti-helix).

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1. Superior semicircular canal.
2. Inferior semicircular canal.
3. Posterior semicircular canal.
4. Section to show spiral lamina.
6. Fenestrum ovale.
11. Auditory nerve divided.
12. Infundibulum.
15. Promontory.
18. Fenestrum rotunda.
21. Filaments of cochlear and vestibular nerves.

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1. Open utriculus.
2. Open sacculus.
3. Superior semicircular canal (memb.).
7. Calcareous substance.
8. Branch of vestibular nerve furnishing
9. Branch of utricle.
10. Branch of superior vertical canal.
11. Branch of horizontal canal.
12. Branch of the saccule canal.
13. Branch of posterior vertical canal.
14. Termination of nerve filaments to the surface of membranous labyrinth held suspended in perilymph.

Figure V.—Membrana Tympani.

1. Membrane of the tympanum.
2. Incus.
3. Short branch.
4. Long branch.
5. Lenticular bone.
6. Stapes.
7. Anterior branch of stapes.
8. Posterior branch of stapes.
9. Base of stapes.
10. Malleus.
11. Neck of malleus.
12. Short apophysis.
13. Handle of malleus.
14. Long process of malleus.
15. Tendon of muscle of stapes.
16. Chorda tympani nerve.

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PREFACE
TO THE
SECOND EDITION.

THE sale of so large an edition as seventeen hundred (1700) copies of the author's work shows the appreciation of the profession of its character and scope.

To make it more truly a clinical manual of the diseases of the ear has been his chief aim.

The opportunities which he has had for the study and treatment of all the varieties of diseases of the ear have been increased since the publication of the first edition, and he has been in no haste to present to his professional brethren crude statements based on the results of a few cases treated. He has added to his twenty-nine (29) years' experience, that at Howard Hospital and a still more extended one at Jefferson Medical College Hospital; this latter during the last six years has numbered ten thousand two hundred (10,200) cases. At each first visit a full history is taken, and daily notes are added, so that each case can be referred to and utilized in contributing to aural surgery and reporting otological novelties, testing various forms of treatment, arranging statistics, etc. In all, two hundred and ninety-four operations were performed, such as those for traumatism, the removal of tumors (fibroid, polypoid, sebaceous, etc.), paracentesis of the membrana tympani, tenotomy of the tensor tympani, perforation of the mastoid process (for abscess), Wilde's post-aural incision for periostitis, incision for supra- and post-auricular subcutaneous inflammation, removal of foreign bodies from the external auditory meatus, tympanum, etc.

The greatest number of visits were made during the winter months, when acute and subacute ear diseases (principally catarrhal) are so prevalent.

The majority of the whole number of cases treated were of middle-ear (tympanal) diseases, and were of the non-purulent form, although there was a large percentage of the chronic purulent variety following scarlatina, measles, and dentition, with a few due to syphilis, trauma, diphtheria, typhoid fever, and sunstroke. Of diseases of the internal ear there were, as usual, but few cases, mostly owing to syphilis, cranial injury, acute and chronic, as well as cerebro-spinal meningitis, typhoid fever, tubercle, concussion, etc. Diseases of the external ear alone, with the exception of eczema of the auricle and meatus, were rare, being, as a rule, symptomatic of existing middle-ear inflammation. Most of the cases of eczema of the external auditory canal were induced by the irritation of instruments of various kinds in the hands of patients, used for the removal of cerumen, or by the free use of the popular remedy "old white Castile soapsuds."

A third trip to Europe (as a delegate to the British Medical Association and International Congress at Amsterdam) furnished him with new facts, instruments, and apparatus. Attendance at the section on Otology was especially advantageous, as was also his visit to Vienna, where he received many kind favors at the hands of his friends Profs. Politzer and Gruber, who gave him free access both to their public and private ear-clinics.

1502 WALNUT STREET, PHILADELPHIA,
October, 1886.

PREFACE

TO THE

FIRST EDITION.

THE small work* of the author being out of print, and a new edition called for, he has embraced the opportunity of entering more fully into the modern doctrines and practice of otologists. It has been his aim to make the work practically useful, and to lay down clear, broad principles for accurate diagnosis and successful treatment. He has not only simply recorded the views and opinions of others, but has added the results of his personal experience in seventeen years' private practice, and in the treatment of several thousand cases in the Aural Department of Howard Hospital.

The number of persons who are more or less deaf from neglect, exposure, or age, and who apply too late for successful treatment, is on the increase. Their condition has been described, and the best artificial aids for their treatment have been fully explained and copiously illustrated.

The subject of rhinoscopy, or the examination of the posterior nares and the pharyngeal orifices of the Eustachian tubes, has received a due share of attention, while an endeavor has been made to represent the appearances of these parts by careful and accurate drawings from nature.

The mode of introducing the Eustachian catheter has been dwelt upon, and two new forms of catheter, with drawings from nature, have been given, the results of numerous experiments on the cadaver, and upon the living subject.

By the use of a new form of double catheter the tube can be more readily washed when it becomes filled with mucus, or when medicated solutions are applied to the middle ear.

---

* The Nature, Causes, and Treatment of Nervous Deafness. Philadelphia, 1863.

The author's object has been to present the subject of diseases of the ear in such a manner that every well-educated physician may approach their treatment with as much confidence as he would the diseases of the heart, lungs, brain, etc. The day has passed for medical men, as a rule, to affirm that they "know but little of the anatomy and physiology of the ear, and nothing about its diseases." A scientific reformation has taken place on the subject of otology, and some of the best men in the profession are devoting their time and talents to its study, in the extended field of the physiological and pathological connection between the organs of sight and hearing, so brilliantly illuminated by the researches of the Marquis of Corti, Profs. Schultz, Helmholtz, and Rüdinger. No small credit is due to the labors of James Jago, M.D., of England, whose original investigations have added much to our knowledge of the various movements which originate in the ear itself, or in adjacent structures, as well as to our knowledge of the true "functions of the tympanum," confirming some of the discoveries of the distinguished Joseph Toynbee, F.R.S., recently deceased, and correcting some of his errors. Advantage has been taken of the important observations of Mr. James Hinton, Aural Surgeon to Guy's Hospital, on nervous deafness, and also of his method of treatment for aural polypi, syphilitic affections of the ear, etc.

For those who desire to study the anatomy and physiology of the ear, more especially the younger members of the profession, the author has had the beautiful model of Dr. Auzoux lithographed by Messrs. Sinclair, in order to fit the work for a text-book; and for the benefit of those whose active employment in general practice renders it difficult for them to obtain a more complete knowledge of the subject, he has added a résumé of the simplest and most effectual methods of treating aural catarrh and other more frequent and curable affections, which, without proper attention, are liable to terminate in permanent deafness.

It has been the author's endeavor to represent all the more important instruments and apparatus employed in aural surgery, in which he has been kindly assisted by our chief surgical-instrument-makers, Messrs. Kolbe and Gemrig, of this city, and several professional friends, who have placed numerous illustrations at his command. In compensation and in illustration he has availed himself of the works of Wilde, Toynbee, Troltsch, Moose, Politzer, Weber, Hinton, Triquet, Voltolini, Kramer, Gruber, Knapp, Schwarze, Green, Clark, and others, as well as of the American and foreign medical periodicals having any bearing on the subject.

The author gratefully acknowledges his obligations to his friends Prof. Meigs, Drs. J. Solis Cohen, James Collins, and Charles F. Wittig, for valuable assistance in the preparation of his work for the press.

L. T.

1208 Spruce Street, Philadelphia,
October, 1871.

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INTRODUCTION.

THE progress of the careful study of ear diseases has been onward. Great success has attended the efforts of those devoted to the subject, especially in acquiring a knowledge of the pathology of the ear. Let me glance briefly at the intimate connection of the ear with other parts of the body, for without this knowledge prognosis will be faulty and treatment empiric.

EAR DISEASES: THEIR GENERAL PATHOLOGY.

Ear diseases: their general pathology points out the analogies between diseases of the ear and those of similar tissues in other parts of the body. The tissues of the external ear are composed of skin, subcutaneous cellular tissue, fat, muscle, yellow elastic fibro-cartilage, and some fibrous tissue. Of the diseases of the skin of the external ear, we have herpes, erythema, eczema, psoriasis, pemphigus, lupus, ichthyosis, and purpura. Here, as elsewhere, we must look for a local or constitutional cause, or for both. The subcutaneous cellular tissue may become inflamed from injury or erysipelatous poison. Of new growths of the external ear, we have, from the subcutaneous fatty tissue, fatty tumors; from fibrous tissue, fibrous tumors; from the blood-vessels, large nævi, and hæmatoma auris. In the meatus externus we have condylomata and epitheliomata, as about the lips.

The skin of the auditory meatus is subject to the same diseases as that of the auricle. The outer half of the auditory canal is subject to an ordinary phlegmonous inflammation of the corium and subcutaneous cellular tissue, while the inner half suffers from a periostitis, and cases of necrosis may result if this inflammation be severe. Furuncles of the external auditory meatus commence in the follicles of the ceruminous glands, hence we find them in the lower anterior wall of the meatus. In the ceruminous glands originate sebaceous tumors, enchondroma; in the cartilage of the wall of the meatus, the bone at the inner end of the canal produces exostoses of both inflammatory and non-inflammatory kind. The outer skin of the membrana tympani is liable to the same diseases as the skin of the auricle; the middle or fibrous layer of the membrana tympani is especially liable to the formation of calcareous deposits, to fatty deposits, and an increased growth of connective tissue. The mucous layer of the membrana tympani is liable to inflammatory changes with usual results.

MALFORMATIONS AND CONGENITAL DEFECTS OF THE EAR.

The auricle is liable to various malformations,—absence or imperfect development (microtia). We have met with such abnormalities as absence of the lobule in each member of a family. The helix, and anti-helix, were in another instance, absent, or so altered as to resemble the cat's ear; in others they were spindle-shaped. The tragus in one otherwise beautiful child was so turned up as to close the meatus. In these rudimentary auricles the dislocated cartilage could be felt under the skin.

In one of these large spindle-shaped ears, in which there were deep indentations with horizontal fissures, the appearance of the auricle was improved by detaching the inner layers, freshening the surface by an operation, and pinning them back so as to become adherent to the skin.

Having operated upon a few cases of atresia of the meatus externus, in which there was deformity of the auricle, there was found, as a rule, complete absence of the auditory canal, and no labyrinth nor internal ear. When the meatus was only covered with true skin, and the auricle normal in appearance, a simple operation was in every instance successful in restoring the canal.

According to Virchow, congenital anomalies in the external ear and its neighborhood are to be accounted for by early disturbances in the closure of the first branchial cleft, and are often associated with fistula of the other branchial clefts,—

cleft-palate, and other forms of arrest of development in the facial bones, with unilateral atrophy of the face.

Rudimentary auricles are not always inserted in the normal position; even well-formed auricles are found on the cheek, neck, or shoulder. As many as four lobules have been found in a case of monstrosity, with double body, which Cassebohm describes,—a child with two ears in the usual situation and two below on the neck. In our own practice we have met with a double auricle in a healthy child,—one in the normal position and one on the side of the face, which we removed. Burkett has reported similar growths in the middle of the sterno-cleido-mastoid muscle.

BRANCHIAL FISTULÆ OF THE EXTERNAL EAR.

A rare form of arrest of development is the "fistula auris congenita," first described by Heuzinger, which, according to our best authorities, is to be regarded as a remnant of the first branchial cleft. The fistulous opening generally lies in front of the ear, usually one centimetre above the tragus (Schwartze), but sometimes it is in the lobule (Betz). A portion of the fistulous canal can sometimes be followed with a fine probe or bristle, or its callous walls can be felt between the auricular cartilage and skin. From its opening a whitish-yellow creamlike fluid exudes, which contains numerous pus-cells.

Paget states: of branchial fistulæ in the *external ears* there is no account on record in this country (England), and foreign literature only yields six or seven cases, most of which are related by Heuzinger. The cases now described occurred in the family of a gentleman perfectly well formed in other respects, who has himself a branchial fistula on the right side of the neck.

His father and a sister, as well as four of his children, had similar malformations, the fistula in two of the latter being on the left side, and on the other two, symmetrically disposed on each side of the neck. But, in addition to these cervical fistulæ, the gentleman himself, his sister, and five of his children each present fistulæ in the helix of one or both ears. These aural fistulæ are minute, their orifices small, and their canal half an inch in length, passing from below forwards and downwards, being less soft and flexible than the cervical fistulæ, producing no secretions, and giving no distress. The coexistence of the latter threw light upon those in the ear, and a similar coincidence had been recorded by Heuzinger. Hence these aural fistulæ are probably due to the incomplete closure of the upper or post-aural fissure, that part of it which does not enter into the formation of the Eustachian tube, tympanum, and external meatus. In other recorded cases the openings have been at the lower or anterior part of the helix or lobule of the ear. It is likely that such cases are not so rare as they seem, and further extensions of the same non-closure of the post-oral fissure might be seen in such malformations as complete transverse partition of the auricle, and one case in which a linear depression on the helix and antihelix was continued on to the cheek, was of like nature. There are now sufficient evidences of malformations due to incomplete closure of every one of the branchial fissures; these aural fistulæ being due to defective closure of the first fissure between the mandibular and hyoid arches, the upper cervical, to the cleft between the thyroid and hyoid, the lower, to the cleft behind the thyro-hyoid arch, and the fourth, to the last cleft above the thorax.

Schwartze writes, "that this form of arrest of development is by no means rare in Germany;" but he and Betz are the only authorities who have seen and described these cases, and no one that we are aware of has published descriptions seen in this country.

AURICLE.

PATHOLOGY.

Diseases of Auricle: Perichondritis Auricularis and Hæmatoma Auriculæ.

Auricle.—The cartilage of the ear belongs to the reticulated variety, and there are sometimes found peculiar alterations which are described by Parreidt (*Dissertatio inaugur. de Chondromalacia*, 1864) and Ludwig Meyer (*Virchow's Arch.*, 1865), such as softening enchondromata and vascular new formations. As observed by Politzer, the softening of the cartilaginous tissue is especially interesting and important on account of its rather frequent occurrence. It leads eventually to the formation of cavities filled with a gelatinous substance. Dr. I. Pollak, who has recently investigated this condition, has arrived at the conclusion that we have here to deal with retrogressive senile metamorphosis of the yellow cartilage, similar to that in other cartilages, as in the costal cartilage. These changes are synonymous with the "vegetable disturbance" (blood dyscrasia, Fischer and Nichol).

As interesting in this connection, we reported four cases of acute inflammation of the auricle (perichondritis) which occurred in our hospital practice within the past two years, three of which patients were males, and one female. In three of the cases there was a distinct history of traumatism of the ear, and, in the fourth, an abscess from blood dyscrasia. In each case there was a distinct red swelling, painful to the touch, filling up the fossa of the helix and anti-helix, but not the lobule, and obliterating the concha, which had increased rapidly after the injury. On incising the swelling, there was found a cavity filled with a grumous-like fluid mixed with fluid blood, and at times yellowish in color, at a late period containing in one case pus, and pus and serum. On opening the swelling and examining by the finger or probe, the perichondrium was, in one case, found separated from the cartilage.

When the tumor is not incised the cyst-like formation remains in this state for months, or pus forms and opens spontaneously, or slowly reduces in size.

The treatment in the first stage is antiphlogistic, with local application of compresses kept wet with a mixture of liquor plumbi, extract. opii, and spiritus vini rectificati. As a rule, the cases rarely present themselves at our hospital in the early stage, or until the fluid has become effused; then the walls must be freely laid open, and drain made by means of a tube or tent, and kept clean by washing with a weak solution of carbolic acid or iodine, else the fluid will accumulate very rapidly. The after-treatment is, painting the parts with tincture of iodine and employing compresses, with a piece of lead wrapped in muslin, attached and supported by adhesive plaster and a bandage. In one case, painting with tincture of iodine, a compress and bandage, was all that was required to effect a cure; but in this there was but a small amount of fluid effused. By this treatment the cases recover with but little deformity, and no loss of hearing, and in no instance did the disease extend into the lobule. It is seldom the case that the fibres of the cartilage extend so far as that part of the ear, but in a few instances we have found them extending even to the middle of the lobule, causing inflammation and abscess following puncturing this part of the ear.

This class of cases, if neglected and of long standing, readily pass into the pathological condition described in the first part of this article, especially in persons of feeble constitution, who have suffered from blows or rough handling, as is sometimes the case among the insane. Kirchner has convinced himself, both by clinical and experimental observations, that the symptoms of lesions of the auricle and the introitus of the meatus do not always correspond with the extent of the traumatic influence, violent symptoms often appearing after even slight injuries. Concerning the influence exerted by destruction of the auricle, its form and position, upon the hearing power, he has convinced himself that the factors named are of subordinate importance.

Of importance are stenosis, or adhesions at the ordinary introitus, which remain after the healing of cartilaginous defects. Lesion of the anterior cartilaginous wall of the ear canal, however, may implicate the parotid gland; that of the posterior wall, the mastoid process. The same author reports a case of injury to the posterior wall, and calls to mind the traumatic case described by Moss (injury from a knitting-needle), which was succeeded by an abscess of the parotid gland. He treats othæmatoma (the old name) by free incision and antiseptic dressing.

Dr. Knapp, New York, called the attention of the profession to perichondritis auriculæ, and reported all that was published on the subject, which was very meagre prior to his own interesting cases. Our cases were published April, 1885, and now the subject is brought before the profession by Dr. Pomeroy, in his work on Diseases of the Ear, devoting from page 57 to 69 to the subject, in which he states that Dr. Knapp's cases strongly resembled his own. From the case which he has published and subsequent ones referred to, he adheres to the opinion that this affection is not identical with hæmatoma auris. After a careful study of the subject, we are fully of the opinion that the diseases of the auricles are identical, and that the differences only depend upon the different circumstances and conditions of the patients. This opinion has been confirmed by the recent account of the blows and rough handling which the insane receive at the hands of some of the attendants, striking them with the open hand or fist; or by the patients themselves bruising the ear against the walls of their cells, during the stage of excitement, and the enclosed wall surrounding the hospital. The resemblance of the two diseases is very strong. In both there is not always an active disease of the cartilage, but in both there are hemorrhages going on and filling up the anterior surface of the auricle. In the cases reported by Drs. Pomeroy and Knapp, the disease of the cartilage was secondary to disease of the tympanum or of the meatus, but in all our cases there was no disease of the meatus, tympanum (middle ear), with perforation of the membrana tympani, which was reported in one case by Dr. Knapp. In one of our cases, almost pure blood and blood-clots were removed on more than one occasion. Others were so mild as to cause merely a simple effusion of blood, and recovery took place with but little deformity: in others the deformity was greater. The color in some was dark red, or light, bright red in others. Febrile symptoms were only prominent when the case was very severe, and where numerous blows had been received. The illustrations of this disease of the auricle in the work of Dr. Pomeroy, with one exception (No. 20), show the same deformity which follows hæmatoma auris or othæmatoma. This treatment is much the same for both forms of disease,—namely, cold in the acute stages; if there is fluctuation, free incision, followed by compression with a bandage. Antiseptic dressing with carbolic acid is employed if the parts do not heal, to which the doctor adds his universal favorite, nitrate of silver solution, as an injection. If the case has passed the acute stage, he recommends (as we do) tincture of iodine applied twice a day; also, not to neglect the symptom of pain, treating it by morphia, and, for the dyscrasia of the blood, tonics, such as bark and iron.

In the case which we had the opportunity of seeing with Dr. Knapp (*Archives of Otology*, vol. ix. p. 195), the lobule remained unaffected. It was, he stated, "a circumscribed furunculous swelling occurring in the cartilaginous part of the ear canal, and from there the inflammation crept slowly over the whole cartilaginous portion of the auricle, forming successively a number of small abscesses on its anterior side, leaving the organ misshapen and considerably swollen." In the five cases which we have seen outside of an insane asylum, the ear, prior to the injury which caused the inflammation, was perfectly healthy, while it is stated that, prior to the occurrence of a true othæmatoma, the tissues of the auricle undergo a softening process (Virchow) or chondromatous change (L. Meyer). These changes are synonymous with the "vegetative disturbance" (blood dyscrasia) of Fischer and Nichol, before referred to.

DISEASES OF THE EAR.

CHAPTER I.

ANATOMICAL DESCRIPTION OF THE EAR AND ITS FUNCTIONS.

THE ear of man is one of the most beautiful and perfect of all his organs. Its most wondrous parts are deeply hidden in the petrous portion of the temporal bone. It is thus protected from external violence, and moreover its mysterious vital actions are thus excluded from the gaze of man.

The ear is divisible into three portions, viz.: the external, middle, and internal.

The external ear or auricle has for its office the collection and augmentation of sounds. It resembles the expanded mouth of a trumpet crushed inwardly, and consists mainly of fibro-cartilage. Its lower pendent portion, called the lobe, consists of connective tissue and fat. To this auricle a thin skin is tightly attached. Connected with it are five small muscles, between the cartilage and the skin, and three larger ones connecting it with the head.

It is divided as seen under Fig. 6.

It is well supplied with blood-vessels from branches of the temporal and external carotid arteries. Its nerves are derived from the great auricular branch of the cervical plexus, the posterior auricular branch of the facial nerve, and the auriculo-temporal branch of the inferior maxillary nerve. Sounds are conducted from the auricle through the external auditory meatus. The latter is a tortuous canal of about an inch in length, directed upward and forward, making a slight turn backward, and finally dips downward and forward to its termination, lined with a skin which is abundantly supplied

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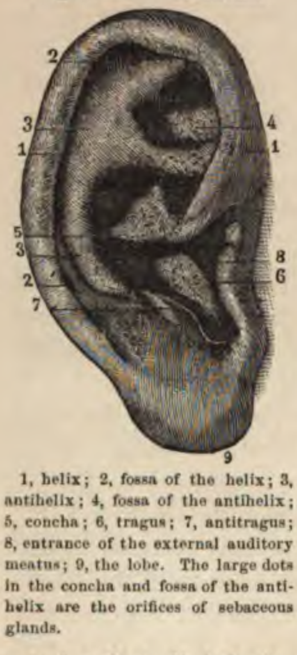
with ceruminous glands, which secrete a bitter waxlike substance called cerumen. This, with numerous projecting hairs, serves to exclude foreign matters, which would otherwise interfere with the function of hearing. The meatus is for about one-third of its length cartilaginous, and in the remaining two-thirds is osseous. These two sections are joined by a membranous layer, giving it the property of extensibility. The anterior wall of the osseous meatus forms the posterior wall of the fossa of the inferior maxilla, and its posterior wall is made up of the mastoid process, so that the canal is separated from the transverse sinus only by two thin plates of bone and the air-cells between them. This canal is closed at its lower extremity by the membrana tympani or "drum of the ear," which separates completely the external from the middle ear, still further occluding the entrance to insects, etc. This is a circular partition, not flat, but slightly funnel-shaped, its outer depressed surface being directed downward and inward. The greater part of its circumference is inserted into a fine groove in the osseous portion of the canal. The size of the membrane depends upon this osseous ring. The ratio of the length to the breadth in the adult is as four and three-tenths lines to four lines. The angle of inclination to the lower wall of the auditory canal is 50°; that of the plane of the membrane with the upper wall is 140°.

Fig. 6.—The Auricle.



1, helix; 2, fossa of the helix; 3, antihelix; 4, fossa of the antihelix; 5, concha; 6, tragus; 7, antitragus; 8, entrance of the external auditory meatus; 9, the lobe. The large dots in the concha and fossa of the antihelix are the orifices of sebaceous glands.

This membrane is thin and translucent, and is composed of three layers: an external dermoid, a middle fibrous, and an internal mucous. The external or dermoid layer is really a delicate continuation of the integument lining the auditory canal; the middle or fibrous is composed of several layers bound together by circular and longitudinal fibres. The internal or mucous layer is a continuation of the lining membrane of the middle ear or tympanum. On examining the membrane from without, we notice a yellowish-white line. This is the handle of the malleus, which is inserted between the laminæ of the fibrous layer. According to Politzer, the color of the membrane is a combination, depending on various factors, viz., the kind of light employed, and the shade of the rays reflected from the promontory. Viewed by daylight, it presents a neutral gray mingling with a tint of violet and a light yellowish brown. If examined by artificial light, it acquires an orange hue. It has a peculiar lustre, and has at the anterior inferior portion a bright spot shaped like an isosceles triangle. This was first described by Mr. Wilde, of Dublin. This curious partition is alternately relaxed and made tense by the action of two small muscles, the tensor and laxator tympani.

Helmholtz has shown that this membrane, while it diminishes the amplitude of the waves of vibration, being curved, increases their force.

The cavity of the middle ear or tympanum (see Fig. 7, H) is filled with ever-renewed air, and is deeply situated in the temporal bone. It measures about two lines from the membrana tympani inward, its breadth and height being about half an inch; and Von Tröltsch compares it to a hexahedron or cube. The horizontal diameter is therefore the greatest. It is about 13 mm. The height or the vertical diameter anteriorly at the tympanic orifice of the tube is only from 1 to 8 mm.; further back at the malleus it is 15 mm. The distance from the membrana tympani to the labyrinth wall is the least. At the mouth of the tube it is from 3 to 4½ mm., but if we measure somewhat farther back in the vertical plane of the malleus we get only 2 mm., at the end of the handle of the malleus, which projects very much into the cavity of the tympanum. This is of course the most convex portion of the drum corresponding to the most concave portion externally—the umbo. This chamber is connected directly with the throat by a canal called the Eustachian tube, through which a current of air passes at every act of deglutition. The cavity of the tympanum is lined with a continuation of the mucous membrane of the Eustachian tube. This lining is provided with a tessellated epithelium, while in the Eustachian tube it is ciliated. According to Tröltsch, the membrane lining the tympanum takes the place of a periosteum by transmitting the blood-vessels which supply the bones. This latter fact is important to notice, as any serious affection of this membrane will ultimately react upon the nutrition of the bones forming this cavity, thus resolving every catarrh into a periostitis. If the inflammation become chronic, there is a great tendency to thickening of the mucous membrane and to hypertrophy of the bones. The existence of a mucous cushion in the cavity of the tympanum was first demonstrated by Tröltsch, and is the reason why affections of the middle ear are so numerous in young children. The close contact of the jugular vein to the cavity of the tympanum exposes it to the influence of pus collecting on its floor.

The Eustachian tube is a trumpet-shaped canal, one and a half inches in length, extending from the forepart of the tympanum obliquely inward, forward, and downward. The upper third, which is connected directly with the tympanum, is an osseous canal formed in the petrous portion of the temporal bone. The lower, we think, communicating with the pharynx, is cartilaginous and gradually expanding in [illegible] having a prominent [illegible] seen [illegible] form, and [illegible] nasal cavity. [illegible] horizontal. [illegible] vertical.

[illegible]

portion of the temporal bone, its fibres lying in close contact with the cartilaginous portion of the tube, but not arising from it.

These muscles have their insertion in the soft palate. In raising the soft palate, these muscles act by constricting the pharynx and elevating the velum palati. By this foreign bodies are prevented from finding their way into the upper part of the pharynx and occluding the Eustachian tubes, as in vomiting, eructations; and yet the walls of the tube lie so lightly against each other that in eructations the wall will separate so that air enters the ear.

"The relations and attachments of the muscles of the Eustachian tube have been recently demonstrated very satisfactorily by Rüdinger.* The tensor-palati muscle is a dilator of the tube; it is inserted along the whole length of the hook of the cartilage, passes forward, inward, and slightly downward, and its fibres spread out along the edge of the soft palate and on the side of the pharynx. In contracting, it draws the hook of the cartilage forward and a little downward, thus enlarging the calibre of the tube. The levator palati takes its origin from the temporal bone just below the osseous tube, and passes along the floor of the tube, some of its fibres arising from the lower end of the cartilage; it is inserted in the uvula, and, in contracting the belly of the muscle which lies along the floor of the tube, becomes thicker; the floor of the tube is raised, and the fibres rising from the cartilage serve to draw the lower end of this away from the opposite wall.

"The palato-pharyngeus rises from the posterior part of the lower end of the cartilage, passes backward, and is inserted on the posterior wall of the pharynx. Its action would be to draw the posterior wall of the tube backward; but, as it is often but slightly developed, it probably only serves to fix the cartilage, so that the other muscles can act more effectively.

"The opening of the tube is thus the result of the action of these three muscles; the tensor palati, or dilatator tubæ, draws the hook of the cartilage outward, the cartilage becomes less curved and the tube is widened; the levator palati in contracting becomes more horizontal, and draws the lower end of the cartilage inward and upward, thus enlarging the pharyngeal orifice more than 3‴. As soon as these muscles cease acting, the elasticity of the cartilage restores the canal to its former condition.

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* Beiträge zur vergleichenden Anatomie und Histologie der Ohrtrompete. München, 1870. American Otological Society Transactions, 1870, pp. 9, 10.

"The papillæ on the dermoid layer of the membrana tympani, first described by Popper as a normal condition, and mentioned in Dr. Roosa's report of last year (1869), are of interest in connection with the polypoid growths which are sometimes found on the surface of the membrane, and which are undoubtedly hypertrophies of these normal papillary projections."

We have already seen, in speaking of the membrana tympani (Plate, Fig. 5), the handle of the malleus, one of a chain of small bones connecting the membrana tympani with the oval window or fenestra ovalis. The malleus or hammer-like bone is situated vertically, with its head lodged in the upper part of the tympanum, and its handle, as before described, inserted between the fibrous layers of the membrana tympani. Its head is round and invested with a cartilage for articulation with the second bone.

The malleus has two important processes arising from its neck; the longer one (Plate, Fig. [illegible] No. 14) is a slender [illegible] from the neck, and [illegible] the shorter one is a conical [illegible] (Plate, Fig. 5, No. 12). [illegible] malleus, near the [illegible] (Plate, Fig. [illegible] No. [illegible]). It has [illegible] (Plate, Fig. [illegible] No. 3), which [illegible] ligamentous band [illegible] the long one is [illegible] and descends [illegible] its end in- [illegible] bone. [illegible] bone, the [illegible] the body next resembles the object after which it is named. Its head is flattened, and at the summit possesses a concave articular process for attachment with the incus. All of these bones have movable articulations, surrounded with capsular ligaments and lined with synovial membranes. Between the malleus and incus the joint is hingelike, and between the incus and stapes it is a ball-and-socket joint. These bones are furnished with three small muscles of the striated variety: the stapedius, laxator tympani, and tensor tympani.

The stapedius muscle has its origin in the hollow of the pyramid, and is inserted into the head of the stapes, and regulates the pressure of the latter against the fenestra ovalis. The laxator tympani arises from the spinous process of the sphenoid bone, passes upward and outward, and enters the glenoid fissure, to be inserted into the long process of the malleus. The tensor tympani arises from the contiguous surfaces of the sphenoid and temporal bones, and the end of the cartilage of the Eustachian tube passes through a canal in the temporal bone above the tube and ends in a tendon which enters the tympanum, and is inserted into the neck of the malleus.

The cavity of the tympanum receives its nourishment through the stylo-mastoid branch of the posterior auricular artery (external carotid), which, in its course through the Fallopian canal, also gives branches to the stapedius muscle, coverings of the facial nerve, and mastoid cells. The ascending pharyngeal artery supplies the lining membrane of the tympanum, the Eustachian tube, and the tensor tympani muscle. The middle meningeal artery (internal maxillary), with one or two branches from the internal carotid, are distributed to the tympanic cavity and the Eustachian tube. The nerves of the middle ear are derived from the trigeminal, the facial, the glosso-pharyngeal, the vagus, and great sympathetic. The otic ganglion and the chorda tympani also supply this cavity.

The internal portion of the ear is the most deeply situated of the three parts, and comprises the labyrinth and the internal auditory meatus. The labyrinth is so named from its exceedingly complex character. It is the most important portion of the organ of hearing, containing as it does the entire distribution of the auditory nerve. It is imbedded in the petrous portion of the temporal bone, and consists of three parts: the vestibule, the semicircular canals, and the cochlea. These may be described as cavities, but it should be remembered that the labyrinth has osseous walls independent of the bony structure inclosing it. The vestibule is an irregularly oval cavity situated between the tympanum and the lower part of the internal auditory meatus, joining the semicircular canals postero-externally and cochlea antero-internally. It communicates with the tympanum through the fenestra ovalis. From the floor of the vestibule springs a slight semicircular crest. This ascends on its inner wall to the roof and terminates in a small pyramidal eminence. This latter presents a group of minute foramina communicating with the internal auditory meatus, and is called the superior cribriform spot. The crest separates two recesses, which, from their shape, are named hemispherical and semi-elliptical fossæ. A second group of foramina below the centre of the hemispherical fossa communicating with the internal auditory is named the middle cribriform spot. Into the [illegible] semi-elliptical fossa open the orifices of the semicircular canals.

The semicircular canals are three in number, and are situated above the inner back part of the tympanum and postero-externally to the vestibule. They are named from their position the superior, posterior, and inferior [illegible]. [illegible] The first two are vertical and the last [illegible]. Each canal is rather more than half a circle, communicating with the vestibule by a flask-like dilatation [illegible] com- [illegible] the remaining [illegible] the [illegible] communicating with the [illegible] orifices. [illegible] the superior semicircular canal [illegible] within [illegible] with the [illegible] [illegible] with [illegible] [illegible] that

Fig. 4), and secretes a liquid called the perilymph. This consists of a pair of communicating pouches occupying the vestibule and semicircular canals and of the same form as the osseous canals containing them. The smaller or spherical saccule (No. 2) occupies the hemispherical fossa; the other or elliptical saccule occupies the hemi-elliptical fossa, and is joined by three membranous semicircular canals (Nos. 11, 12). The membranous labyrinth is composed of an outer fibrinous layer and an inner tessellated epithelium, containing a serous liquid called the endolymph. The vestibular branch of the internal auditory nerve is distributed to the membranous labyrinth, and maintains its floating position in the perilymph. This nerve divides at the bottom of the internal auditory meatus into three branches, one of which, entering the vestibule at the superior cribriform spot, is distributed to the elliptical saccule and the ampullæ of the superior and inferior semicircular canals.

A second, entering at the middle cribriform spot, is distributed to the hemispherical saccule.

The third, entering at the inferior cribriform spot, is distributed to the ampulla of the posterior semicircular canal. Adhering to the inner surface of the spherical and elliptical saccules, where the nervous filaments from the cribriform spots enter, are two white discoidal masses, called otolites. These appear to be in contact with the nervous filaments of the saccules (Plate, Fig. 4, No. 7). The arteries of the vestibule and semicircular canals are derived from the vestibular branches of the auditory artery which accompany the branches of the vestibular nerve. The *cochlea* (Plate, Fig. 3) is the innermost portion of the labyrinth, and is so named from its resemblance to a snail's shell. Its base is applied to the bottom of the internal auditory meatus, and its apex is directed forward and slightly outward. This osseous tube is an inch and a half in length, wound nearly three times around a central axis, each turn successively rising. The beginning of this tube is connected with the front part of the vestibule, forming the promontory* of the tympanum. It turns from right to left in the right ear and from left to right in the left, and ends in a closed extremity named the cupola. The axis of the cochlea is a cone whose base forms a spiral tract at the bottom of the internal auditory meatus, and whose apex becomes continuous with the inner wall of the last turn of the canal of the cochlea. It is traversed by numerous fine canals continuous with the foramina of the spiral tract, which transmit the filaments of the cochlear nerve; also cochlear branches of the auditory artery. A central canal extends the length of the axis, transmitting a branch of the latter vessel. An osseous spiral lamina commences below the hemispherical fossa of the vestibule, and winds around the axis of the cochlea and extends about half way across its canal, terminating in a pointed process at its apex. The cochlea is lined by a delicate membrane continuous with and similar to that of the vestibule. This, after investing the free surfaces of the osseous spiral lamina, is extended in a double layer from the free border of the latter across the canal of the cochlea, where it is firmly attached to its outer wall. This extension of membrane, which is named the membranous spiral lamina, together with the osseous spiral lamina, divides the canal of the cochlea into two distinct passages, communicating with each other only at the summit of the cochlea. At the lower extremity of the cochlea, one of these passages terminates at the fenestra rotunda, and is named the tympana scala, while the other opens into the vestibule, and is called the vestibular scala. Both scalæ are filled with a serous liquid, which communicates with the perilymph of the vestibule, but is

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* The promontory is a convex eminence on the inner wall, formed by the projection of the cochlea. Back of the upper part of the promontory is the

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fenestra ovalis (see Plate, Fig. 3, No. 6) or oval window, which is closed by the base of the stapes. Above the oval window is a ridge formed by the course of the Fallopian canal, which transmits the facial nerve (see Plate, Fig. 2, No. 11). From this ridge there projects forward a hollow conical eminence, called the pyramid.

Behind the lower part of the promontory is a fossa, at the bottom of which is an aperture called the fenestra rotunda or round window (see Plate, Fig. 3, No. 18). This communicates with the cochlea, but is closed by the membrana tympani secondaria, which consists of a fibrous layer invested internally by the lining membrane of the cochlea and externally by that of the tympanum.

prevented from escaping by the secondary tympanic membrane at the round window. The internal auditory nerve gives off the cochlear branch, which is resolved into a multitude of filaments; these, with branches of the corresponding artery (auditory), enter the foramina of the spiral tract at the bottom of the internal auditory meatus. These ascend the canals of the axis of the cochlea and are reflected outwardly to the osseous spiral lamina, within which they form an intricate plexus, becoming associated near its free border with a series of nerve cells. From these emerge the nerve fibres to enter the membranous spiral lamina, where, with peculiar nerve cells, they form a complex arrangement.

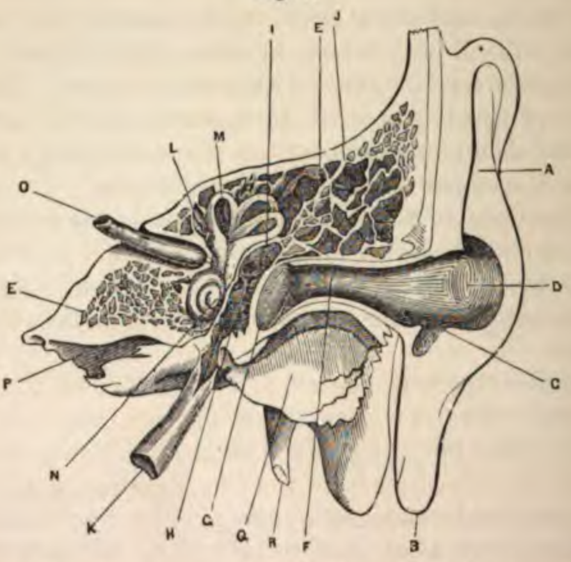
The arteries supplying the cochlea are mainly derived from branches of the internal auditory artery. They terminate in a capillary network on the lining membrane and spiral lamina, from which veins originate and join the spiral venous sinus in the axis of the cochlea.

CHAPTER II.

PHYSIOLOGY OF HEARING.

By the sense of hearing, sounds produced by bodies in a state of motion are recognized. If these vibrations are regularly and rapidly propagated by the corresponding waves or undulations produced through the surrounding aerial medium, they produce a musical note. Liquids or solids transmit these vibrations more readily. The air is the ordinary medium, and no sound can be propagated in a perfect vacuum. Thus, by ringing a bell in a jar from which the air has been entirely exhausted, no sound is produced. The canal (Fig. 7, D) into which the external ear reflects the sonorous vibrations passes inwardly until it is closed by the membrana tympani or "drum of the ear" (G).

Fig. 7.



This delicate membrane moves under the influence of these vibrations, and communicates the motion first to the malleus, the long handle of which is inserted vertically between the laminæ. Its head is articulated with the body of the incus, the long process of the latter being connected with the stapes. The oval extremity of the stapes is attached to the membrane covering the fenestra ovalis or entrance to the labyrinth.

According to Helmholtz, by the transference of the vibrations of the tympanum to the much smaller membrane of the fenestra ovalis, thus throwing the somewhat movable liquid into vibration, mechanical power is gained. The apparently loose connections of the tympanic ossicles would seem to be unfavorable to the transmission of delicate vibrations. Helmholtz shows, however, that the firmness of the bony chain is much greater than has hitherto been supposed. Among other things, he points out that the articular surfaces of the malleus and incus are furnished, on their inferior aspects, with little processes or teeth (Sperrzähnen), which are so placed that, when the malleus moves outwardly, the articular surfaces easily separate as far as the somewhat loose capsular ligament will allow. When, however, the malleus moves inwardly, it grasps the incus with great firmness. The consequence of this is that when air is blown into the tympanic cavity, the membrana tympani can move outwardly without dragging the stapes out of the fenestra ovalis.

The functions of the tympanum are to render the vibrations of the membrana tympani quite free, and to isolate the chain of bones in such a manner as to prevent their vibration from being weakened by diffusion through the surrounding parts.

Opinions differ with regard to the function of the Eustachian tube. The one most commonly entertained is that it serves the same purpose as the hole in an ordinary drum, by removing an impediment to the free vibration of the membrane that would be offered by the complete inclosure of the air within. This is at once negatived by the fact, demonstrated by Mr. Toynbee and Dr. Jago,* that the guttural orifice of the tube is usually closed, being only opened in the act of swallowing.

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* Functions of the Tympanum, by Jas. Jago, M.D., Brit. and For. Med.-Chir. Review, January and April, 1867.

The principal object of the Eustachian tube, which is always found where there is a tympanum, appears to be to maintain an equilibrium between the external air and the air within. Dr. Jago believes that the ingress of aerial undulations from the throat, prevented by the normal condition of closure of the tube, would cause incessant oscillation of the membrana tympani, and that as the moment seized for bringing the tympanum into communication with the fauces must be one at which there can be no respiratory current, the period selected is the instant of swallowing, at which there is a compulsory suspension of respiration. Finally, the same arrangement secures the tympanum from the intrusion of gastric gases, etc. evolved through the fauces. This rule is not absolute, as they enter the tympanum strongly enough to palpably give a momentary protrusion to the membrane. The correlation between the Eustachian tube and the glottis should be thus expressed: the Eustachian tubes are shut whenever the glottis is open, but whatever act closes the latter opens the former.

Dr. Jago has a personal advantage in aural researches, owing to the fact that the guttural orifice of one of his Eustachian tubes can be opened and closed at will. The writer has a friend who has the same power, and who has repeated with him numerous experiments in confirmation of Dr. Jago's views. There are times when one of these tubes opens and remains so without any disposition to close. The writer has suffered from this condition, and the act of blowing the nose is attended with a sensation as though there was a perforation in the membrana tympani. This condition is always attendant on catarrh. When Dr. Jago has suffered from this patency of the tube, he has been able to close it for some moments, by an inspiratory movement with the nose and mouth closed, thus diminishing the aerial pressure in the throat. Again, he has found that a hearty meal would remedy this condition for several hours, if not for the remainder of the day. This, he thinks, is caused by the faucial tissue absorbing moisture directly from the fluids swallowed. It is now fully fourteen years since the phenomenon of an open Eustachian tube has been understood, and as physician to two charities, and in general practice, he has met with numerous patients who were affected with aural symptoms, yet he has never met with an instance of a permanently patent tube.

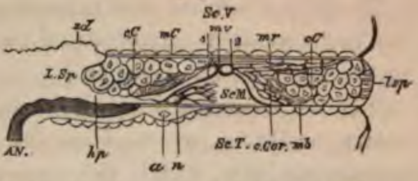
The results of numerous experiments have persuaded Dr. Jago that both exhaustive and condensive stretching of the membrana tympani impedes the hearing of all tones, and more so when they are due to larger waves. In this he differs from many observers; and he also thinks that we never enjoy the privilege of hearing through the membrana tympani, or any thread of it, vibrating after the mode of musical strings—that is, in virtue of a given degree of tension. This explanation plainly coincides with the theory which makes the membrana tympani oscillate laterally, carrying with it the ossicular columella. From other experiments evidence was adduced that the membrana tympani will receive sonorous vibrations from a solid rod and (a fact incompatible with the fibre theory) a given tone at any point of its surface. He also concludes with confidence that aerial sonorous vibrations so interpenetrate the membrana tympani that it can perform its functions without lateral vibrations, even though it should not prove that it never performs them in that manner. If therefore the aerial sonorous vibrations make their way into the substance of the membrane, may not the precise constitution of the outer surface be of much acoustic moment?

The vibrations transmitted to the membrane covering the fenestra ovalis act upon the fluid contained within the labyrinth. This consists of the vestibule (Fig. 7, L), the semicircular canals (M), and the cochlea (N). Evidently the vestibule corresponds with the simple cavity constituting the entire organ of hearing in the lower animals. The vestibule is subdivided by a membranous partition into two cavities, in which are found small rounded masses of concretionary particles, collectively named otoconea and singly otolites. In animals, in which the auditory apparatus is less perfect, they are seen to be quite large, seemingly needful to intensify sounds. From investigations in comparative anatomy, Goodsir concludes that "the vestibule is that part of the organ by means of which any sound or series or combination of sounds is heard merely as noise." The simplest form of ear, which consists of a vestibule only, probably enables the sensorium merely to become cognizant of sound irrespective of the pitch or harmony of its constituent tones.

The semicircular canals (Fig. 7, M) have their functions variously estimated. It is commonly supposed that they receive the impression by which we distinguish the direction of sound; and it is certainly a powerful argument in support of this view that in almost every instance in which these parts exist at all they hold the same relative positions as in man, their three planes being nearly at right angles to one another. Prof. Samuel Jackson, of the University of Pennsylvania, believes that their function is to suppress sonorous vibrations, or to act as a damper, thus subserving to hearing the same purpose that the pigmentum nigrum does to vision. Flourens concludes, on making sections of the semicircular canals in pigeons, that the nerve supplying them does not minister to the sense of hearing, but to the directions of the movements of the animal; but this is fully explained on the supposition that the normal function of the semicircular canals is to indicate to the animal the *direction* of sounds, and that its movements are partly determined by these; so that a destruction of one or other of them will produce an irregularity of movement, resulting, as it would seem, from a sort of giddiness on the part of the animal, just as when one of the eyes of a bird is covered or destroyed.

M. Dugès surmised that by the cochlea we are especially enabled to estimate the pitch of sounds, and he adduces in support of this idea the fact that the development of the cochlea follows a very similar proportion to the compass of the voice. Dr. Thomas Young regards the cochlea as a micrometer or measurer of sound. Kölliker put forth a similar idea; and Helmholtz has confirmed these views by his researches. Microscopical investigation, with delicate dissections by Corti, Schultze, Kölliker, and others, have elucidated the structure of the cochlea.

Fig. 8.



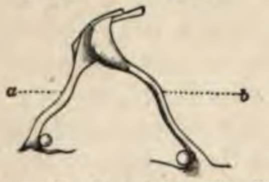
"The canal of the cochlea, according to Kölliker, is filled with the fluid of the labyrinth, and contains not only two well-known cavities, the scala tympani and the scala vestibuli (*Sc V* and *Sc T*, Fig. 8), but also a third narrower space, which he proposes to call the scala media (*Sc M*). This is situated, in a great measure, within the lamina spiralis, and contains the ultimate terminations of the cochlear branches of the auditory nerve. The lamina spiralis consists of an inner bony and an outer membranous portion; the former terminates by a grooved edge, the upper margin of the groove (*zd*) being termed the zona denticulata, in consequence of its presenting a series of well-marked teeth; the lower margin (*hp*), the habenula perforata. From each of these a layer of periosteum is continued to the opposite wall of the cochlea, completing the septum between the scala tympani and scala vestibuli. The upper layer is termed the membrane of Corti (*m C*), the lower one the membrana basilaris (*mb*). Connected with the habenula perforata and lying in the scala media, or space between the two membranes, are certain structures termed the rods of Corti. These (1 and 2) form an angle with one another resembling the gable end of a house, and appear to be connected above by a delicate membrane, the membrana velamentosa. The spaces between the grooves of the bony lamina spiralis and the first set of the rods of Corti, and the space between the outer wall of the cochlea and the second set of the rods of Corti, are filled with large nucleated cells (*c C*), the cells of Claudius. The interval between the two sets of rods and the membrana basilaris (*Sc M*) is probably filled with fluid. The branches of the auditory nerve lie on the under surface of the lamina spiralis, beneath the habenula perforata, through which they pass by many small openings, and (though there is much difficulty in following them at this part) apparently terminate by free and extremely delicate extremities among the cells of Claudius and in the fluid of the scala media.

"The diagram on preceding page will give some idea of the relations of these delicate parts as they appear to be determined by the most recent investigations."*

To fully illustrate this intricate and yet interesting subject, we have availed ourselves of the description and drawings in the work of Dr. Gruber.†

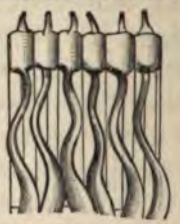
"If we examine into the minute structure of the membrana basilaris, we find as its foundation a structureless membrane, into which the upper plate of the labium tympanicum is transformed. This, particularly at the outer border, is found covered with a peculiar warty formation which gives the part different transverse diameters. These diameters vary from 0·012 to 0·025 mm. Upon this structureless membrane rests the formation designated as Corti's organ. Following next in order after the labium tympanicum of the sulcus spiralis are the so-called Corti's fibres (teeth of the second row, Corti; little rods, Claudius; arched filaments, Hensen; hearing rods, Henle,—Figs. 9 and 10).

Fig. 9.—Corti's Fibres in Natural Position.



a, ascending fibres; *b*, descending fibres. On their upper ends are seen the little rods, towards their lower ends and towards the concavity of the arch, the nucleus.

Fig. 10.—Corti's Fibres lying over one another.



The descending fibres are plainly seen, with the little heads or projections placed upon their connecting parts.

"They appear to be the most important formations of the whole Corti's organ. They have their origin in the neighborhood of the foramina of the habenula perforata, and terminate again in the membrana basilaris. They lie side by side along the whole membrana basilaris, leaving between them spindle-shaped gaps, in such a manner that when viewed from above their arrangement exhibits a similitude to the keys of a piano. Corti's fibres which, in their chemical composition, show not the slightest resemblance to the membrana basilaris, dissolve readily in diluted caustic soda and potassa, and likewise in dilute hydrochloric acid; while alcohol, ether, chromic acid, saturated solutions of salt and sugar only cause them to shrivel (Kölliker); and they are then seen to consist of two parts, which are archlike and united, so that in their route along the whole ductus cochlearis they must form a slightly convex and also longitudinal protuberance. According to position, Corti's arches consist of an inner (*a*) and an outer (*b*) Corti's fibre, the former being (according to Claudius) more numerous; so that there are only two outer fibres for three inner ones.

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* See M. M. Fick, "Anatomie und Physiologie der Binnes-Organe," 1862, p. 122; Carpenter, Principles of Human Physiology, sixth edition, p. 663, London, 1864.

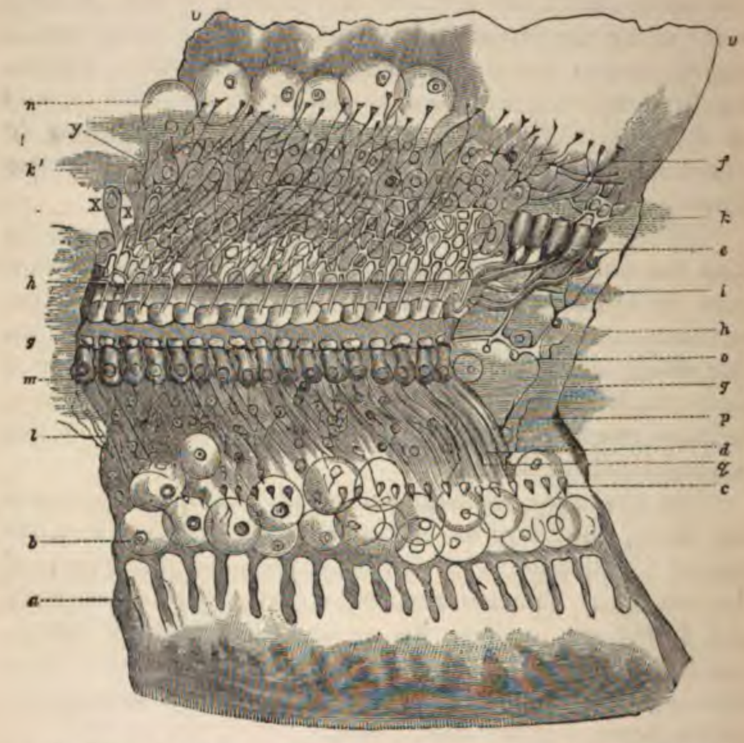
† Lehrbuch der Ohrenheilkunde mit besonderer Rücksicht auf Anatomie und Physiologie, von Dr. Josef Gruber, Vienna, 1870, pp. 130–136.

"The inner fibres, which Deiters describes as less flexible than the outer ones, all begin regularly in a line outward from the foramina of the habenula perforata. At their commencement they are somewhat broader than they are farther along, and show, according to Kölliker, on one side of their origin a nucleus, which is attached to the fibre by a delicate membrane, which this author believes to be the principal cell constituent.

"The fibre runs, ascending outward and upward (ascending fibre), until it joins the broad end; hence the centre part of Corti's fibre is its narrowest part, and the upper end the broadest. The latter shows a cavity pointing outward and downward, in which fits an arched segment of the descending fibre to be shortly described. These two parts form in Corti's arches the so-called articulations (coins articulaires internes et externes, Corti).

"The expanded and inward convex piece of the descending fibre just mentioned lies the highest, yet it does not expose its upper end; while its expanded part above is covered by the outer flat ends of the ascending fibre. In immediate continuation runs still another fibre, so that the upper end of the descending fibre appears turned or lapped over in an archlike manner. In their farther course downward, the descending fibres diminish very strikingly, to be finally reinserted with a broader bell-shaped end on the membrana basilaris. This end (according to Kölliker), towards the concavity, and likewise on the starting-point of the ascending fibre, contains a nucleus, which is not always to be found on the single fibres

Fig. 11.—THE ENTIRE MEMBRANA BASILARIS, WITH ALL ITS PARTS LYING EXPOSED FROM ABOVE TO SHOW THE PROPORTION OF NERVES.—CORTI'S ORGAN FROM THE SIDE. (After Deiters.)



a, the teeth; *b*, the large cells which fill the sulcus, partly passed forward; *c*, holes or foramina of the habenula perforata; *dq*, inner Corti fibres; *e*, outer Corti fibres; *f*, connecting rods detached; *g*, the first bundles of the transverse nerve fibres; *h*, the second from above respiratory outward: in these are seen the so-called phalanges; *i*, the third; *k*, the fourth; *l*, arising longitudinal nerve fibres, which submerge in the first bundle of the transverse ones; *m*, cylindrical cells on the lower arch of the pars membranacea; *n*, the cells of Claudius on the connecting rods; *o*, the supporting fibrous system of Corti's organ; *p*, a longitudinal nerve fibre on the base of Corti's arch; *x*, cells of Corti; *y*, fusiform cells.

when detached from their insertion. The diameter of the little rods varies from 0·001 to 0·002 mm.*

"The second formation, which constitutes Corti's organ (see Fig. 11), is the lamina reticularis cochleæ discovered by Kölliker (lamina velamentosa, Deiters). Fig. 8, 1, 2.

"It is named after its discoverer, and is one of the most difficult parts of Corti's organ to delineate, especially if the object be to define its proportions exactly; and concerning no part of the cochlea is there such a variety of opinions as of this. Kölliker describes it, first, as a short, clear plate with fine bordered divisions, corresponding in numbers with the inner Corti's fibres. This plate presents on the border the inner and outer Corti's fibres, and is in close connection with the former, and consists in a union of appendages of the inner fibres, which Kölliker calls plates. After these plates follows a netlike lamella, consisting of longer straight rods (*f*) enlarged at their extremities, whose numbers correspond with those of the outer Corti's fibres, and which are connected with the jointed ends of the same in a manner not satisfactorily solved. These rods, which lie close under the clear plate, show, near the edge of the latter, a slight, sometimes nodular, protuberance. Upon these rods follow smaller ones, situated between the outer ends of the former pieces, in the shape of a biscuit, which Kölliker calls 'inner intermediate parts' (Deiters's phalanges of the first row), (*h*); then, the outer intermediate parts, in shape similar to the former, between the ends of the inner parts (Deiters's phalanges of the second row); and lastly, a row of parts which sometimes appear as four small rectangular portions lying close together, in whose outer ends hair-shaped appendages appear.

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* Henle divides the ascending fibres into two species: the first being flattened in a direction perpendicular to the membrana basilaris. The transverse section is elliptical, almost double the length, through the long diameter. The body of the other is cylindrical, only broad toward the ends. He can distinguish these two forms, but believes that the difference is only determined by the position of the objects. The bodies of the descending fibres are always cylindrical.

"The intermediate parts (phalanges) leave between them three rows of foramina, at regular distances, which Kölliker calls inner, middle, and outer holes (rings, Böttcher; circles, Deiters) of the lamina reticularis.

"According to Henle, the lamina reticularis appears partly in the form of a network of fine hyaline threads, with regular, partly four-sided, partly round, meshes, which alternate in three rows, in such a manner that, as a general rule, these little frames, which divide the foramina of the first row from those of the third one, touch upon the middle of the foramina of the second row.

"The outer edge of the third row of meshes lies just over the place of insertion of the outer Corti's fibres, on the membrana basilaris. In other cases (both forms appearing in the same species of animal), the threads of the net are finer, the meshes closer, partly or entirely closed by delicate membrane, with the exception of the three constant rows of round openings.

"Deiters found, sometimes, the round meshes divided by a small archlike cross-piece. As before mentioned, the enlarged rods, which are connected with the joint ends of the descending Corti's fibres, have the form of a ship's rudder, and their somewhat enlarged ends are inserted in depressions of the outer edge of the joint ends of the outer Corti's fibres. These would effect the closing of the innermost meshes of the lamina reticularis.

"While the origin of the lamina reticularis, from the joint ends, is given with certainty, as well as its parallel course with the membrana basilaris, no certain knowledge exists about its insertion. Henle says, under the supposition that it is attached somewhere to the wall of the cochlea, one might assign to it the function of a band, which fastens the little rods in their position. In chemical construction the lamina reticularis resembles Corti's fibres. Besides the structures already mentioned, other cell formations belong to Corti's organ, which converging form and arrangement may partly be designated as epithelium cells; others, however, are not known in their origin, and are named either after their discoverer, or after their peculiar form.

"Here belong the hairy cells (stalky cells of Corti; thorn cells of Leidy; staff cells of Hensen; inner and outer covering cells of Henle). The nomenclature of Henle is derived from their relation to Corti's fibres. He distinguishes the cells here mentioned, according as they are above or under Corti's fibres, as cover and floor cells; if both, according to their position upon the membrana basilaris, *outer* or *inner*. About the hair cells, which constitute the most delicate formation of the whole Corti's organ, in their relation to their neighboring formation, we are instructed in many particulars by Deiters, Kölliker, Hensen, and lately also by Henle. The inner hairy cells are found upon the joint ends of the inner Corti's fibres; they pass backward on the epithelium of the labium tympanum, by which they are partly covered.

"Their form, as Henle remarks, is conical (*m*), whereby the broader end is directed more outward and upward, and carries a bundle of stiff cilia, which may be noticed distinctly upon single cells which evidently lie toward the edge. The inner hair cells, which, as Kölliker remarks, have their seats in three rows alternately on the holes of the membrana basilaris, and likewise have a more conical configuration, run over the outer Corti's fibres downward, and carry on the upper ends just such cilia as the inner hairy cells. The three rows of the outer hairy cells cover one another partly until shaped, and lastly change at the ends to fine thin threads, which are inserted in three rows placed alternately on the membrana basilaris (Deiters).

"On the upper ends adhere the hairy cells which cover the foramina of the lamina reticularis, close to the borders of the foramina of the same, in such a manner that, by their attachment, the upper part of the cell frequently remains closed. These hairy cells, which were known to Corti, although superficially, go by the name of Corti's cells in contradistinction to Corti's fibres.

"Deiters has discovered still other hairy cells, independent of the inner cells, which run in three rows between and outward from those described. Deiters's hairy cells adhere with their inner ends to the outer ends of the so-called phalanges, with their outer ends toward the membrana basilaris. They are spindle-shaped, and their ends diverge in long, fine threads. The outer end, before its insertion on the membrana basilaris, unites with the outer fine end of one of Corti's cells in such a manner that their insertion is a common one,—the thin end of Deiters's cells uniting the rods. In addition, other cells on the membrana basilaris have more the property of epithelium cells, particularly when treated with water, as they puff up and assume a ball-like form; one sees these especially well under Corti's fibres (Deiters's support tissue; Stützgewebe). Henle's floor cells, on the membrana basilaris, beyond the insertion of the uniting stems, are smaller and larger as such cells are present.

"The outer zone (zona pectinata) is that outer portion of the membrana basilaris which unites the inner zone with the wall of the cochlea. It shows on its upper plane, toward the ductus cochlearis, a ribbed, comblike appearance, from whence it derived its name, membrana pectinata (Todd and Bowman). These ribs, which, especially on the outer section, do not spread out entirely straight, but are somewhat waving, and which were formerly taken to be an expansion of a fold of the structureless membrane (which, as Henle has lately shown, originate from fibres which have a diameter of 0·0025 mm.), are not always single-radiating, but are wavelike, and bend, especially on the outer ends. To the outer side, toward the wall of the cochlea, slight depressions present themselves on the zona pectinata; and here, according to Kölliker, it receives a fibre-mass coming from the lamina spiralis, ossea accessoria, which this author described as ligamentum spirale, while Todd and Bowman looked upon this structure as muscular, and named it musculus cochlearis.

"According to Henle, the zona pectinata is strengthened by several uniting tissue-strings extending on its tympanic surface, running parallel with the longitudinal axis of the lamina spiralis.

"The vestibular wall of the ductus cochlearis, the membrana Reissneri, shows, besides its covering of epithelium, a thin layer of simple connective tissue, and numerous capillaries, which stretch from the periosteum of the lamina spiralis close upon the periosteum of the cochlea. From the insertion of Reissner's membrane to the insertion of the membrana basilaris, the periosteum of the cochlea forms the outer wall of the ductus cochlearis. This shows, besides the epithelium, a thin layer of tissue, abundantly supplied with vessels (stria vascularis, Corti), and outward from this a tissue-plate, which consists, according to Kölliker, of cells which have a great resemblance to cartilage cells.

"Besides this outer wall of the ductus cochlearis, we find, on observing further, immediately over the insertion of the membrana basilaris, a protuberance, extending far toward the canal, which, Hensen states, contains a vessel (vas prominens, Hensen), of the presence of which Henle, however, could not convince himself."

The number of the rods of Corti is estimated by Kölliker at three thousand, or about three hundred to each semitone of the octave.

Besides the structures just enumerated, there are within the labyrinth certain fine elastic bristles terminating in sharp points, between the internal nerve fibres. These bristles, discovered by Max Schultze, are eminently calculated to sympathize with those vibrations of the fluid of the labyrinth which correspond to their proper periods. Thrown into vibration, the bristles stir the nerve fibres which lie between their roots. At another point in the labyrinth we have the otolites already noticed as imbedded among the nervous filaments, which, when they vibrate, exert an intermittent pressure upon the adjacent nerve fibres, thus exciting audition.

Finally, according to Helmholtz, this wonderful organ in the labyrinth, discovered by Marchese Corti, which we have described, is to all appearances a musical instrument, with its cords so stretched as to receive vibrations of different periods and transmit them to the nerve filaments which traverse the organ. "Within the ear of man, without his knowledge or contrivance, this lute of three thousand strings has existed for ages, receiving the music of the outer world and rendering it fit for reception by the brain. Each musical tremor which falls upon this organ selects from its tensioned fibres the one appropriate to its own pitch, and throws that fibre into unisonant vibration. Thus, no matter how complicated the motion of the external air may be, these microscopic strings can analyze it and reveal its constituents."*

"This idea has been confirmed by the recent microscopic researches of M. Victor Hensen† on the hearing of crustaceous fishes. Having placed the decapoda in salt water, charged with strychnia to increase the reflex power of the cerebral nerves, the animal fell into convulsions at the least noise. He has proved afterward that in them hearing takes place through the medium of hearing-bristles, and that each little fibre vibrates in unison with a determined note."

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* Tyndall.

† Helmholtz, Die Lehre den Tonempfindung; L'Acoustique, par Rodolphe Radau, p. 291. Paris, 1870.

CHAPTER III.

ACOUSTICS.—LAWS OF SOUND.

"ACOUSTICS (derived from the Greek verb ἀκούω, "to hear") treats of the science of sounds, their cause, nature, and phenomena. Sound is the impression (or motion) produced on the sense of hearing by the vibration of sonorous bodies."

If it be a series of irregular vibrations, it is called a noise; but if it be a succession of rhythmic impulses, a musical tone.

The ear is capable of appreciating the three fundamental qualities of sound, viz., intensity, or amplitude of vibration; pitch, or rapidity of vibration; and timbre, or quality.

Higher tones mingle with the fundamental tone, determining the pitch of a sound, or its value in the musical scale; and it is this intermixture which determines what, for want of a better term, we call the *quality* of the sound.

It is this union of high and low tones that enables us to distinguish the sound of one musical instrument from another.

Most sounds have a series of impulses partaking in a greater or less degree of the character of a musical tone.

Any continuous sound is dependent upon a succession of impulses, and the rapidity with which these succeed one another determines the pitch of the tone. We may ascertain by experiment what number of such impulses are required to give a musical tone of any pitch.

Thus if the instrument called the siren, composed, in its simple form, of a circular plate with a number of apertures at regular intervals, be made to revolve over the top of a pipe through which air is propelled, a succession of short puffs will be allowed to issue from this; and if the revolution be sufficiently rapid, these impulses will unite into a definite tone.*

These vibrations are transmitted from the external ear by a special nerve, the auditory, and are recognized by the brain as sound.

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* Tyndall on Sound.

Sounds are propagated through the air in waves, which may be transmitted simultaneously in different directions without destroying each other.

This is illustrated in complicated pieces of music played by an orchestra; a practiced ear can readily distinguish the sound of each instrument.

It has been estimated that the number of complete vibrations required to produce an appreciable musical sound, in persons having an acute sense of hearing, may vary from eight for the lowest to thirty-six thousand five hundred for the highest, per second.

Helmholtz has recently fixed the lower limit at sixteen vibrations and the higher at thirty-eight thousand vibrations per second.

The practical range of musical sounds is comprised between forty vibrations and four thousand vibrations per second, which amounts in round numbers to seven octaves.

Weakening of sound, which takes place according to the law of inverse squares, would be in great measure prevented if the sound-wave were so confined as to impede its lateral diffusion.

By transmitting it through a tube with a smooth interior surface, we accomplish this, and the wave thus confined may be transmitted great distances with very little diminution of intensity. This condition is fulfilled and utilized in the speaking-tubes in our dwellings.

"The celebrated French philosopher Biot observed the transmission of sound through the empty water-pipes of Paris, and found that he could hold a conversation in a low voice through an iron tube 3120 feet in length. The lowest possible whisper, indeed, could be heard at this distance, while the firing of a pistol into one end of the tube extinguished a lighted candle at the other.

"The action of sound thus illustrated is exactly the same as that of light and radiant heat. They, like sound, are wave motions. Like sound, they diffuse themselves in space, diminishing in intensity according to the same law. Like sound also, light and radiant heat, when sent through a tube with a reflecting interior surface, may be conveyed to great distances with comparatively little loss. In fact, every experiment on the reflection of light has its anologue in the reflection of sound.

"The limits of hearing are different in different persons. Dr. Wollaston, who gave the first proof of this, while endeavoring to estimate the pitch of certain sharp sounds, remarked in a friend a total insensibility to the sound of a small organ-pipe, which, in respect to acuteness, was far within the ordinary limits of hearing. The sense of hearing of this person terminated at a note four octaves above the middle E of the piano-forte.

"The squeals of the bat, the sound of a cricket, even the chirp of the common house-sparrow, are unheard by some people who for lower sounds possess a sensitive ear. The ascent of a single note is sometimes sufficient to produce the change from sound to silence.

"The suddenness of the transition," writes Wollaston, "from perfect hearing to total want of perception, occasions a degree of surprise which renders an experiment of this kind with a series of small pipes among several persons rather amusing. It is curious to observe the change of feeling manifested by various individuals of the party, in succession, as the sounds approach and pass the limits of their hearing. Those who enjoy a temporary triumph are often compelled, in their turn, to acknowledge to how short a distance their little superiority extends."*

Nothing can be more surprising, writes Sir John Herschel in reference to this subject, than to see two persons, neither of them deaf, the one complaining of the penetrating shrillness of a sound, while the other maintains there is no sound at all. Thus, while one person mentioned by Dr. Wollaston could but just hear a note four octaves above the middle E of the piano-forte, others have a distinct perception of sounds full two octaves higher. The chirp of the swallow is about the former limit, the cry of the bat about an octave above it, and that of some insects probably another octave higher.

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* Tyndall on Sound, p. 73.

In "The Glaciers of the Alps," Dr. Tyndall has referred to a case of short auditory range, in crossing the Wengern Alp in company with a friend. The grass at each side of the path swarmed with insects, which to him rent the air with their shrill chirping. His friend heard nothing of this, the insect music lying quite beyond his limit of audition.

Once, while crossing the Stelvio Pass by night in company with a friend, he complained of acute pain in the ears. Dr. Tyndall desired him to swallow his saliva: he did so, and the pain instantly disappeared. By the act of swallowing, the Eustachian tube is opened, and thus equilibrium is established between the external and internal pressure.

Dr. Wollaston was expert in closing the Eustachian tube and leaving the space behind the tympanic membrane occupied by either compressed or rarefied air. He was thus able to cause his deafness to continue for any required time without any effort on his part, always, however, abolishing it by the act of swallowing. A sudden concussion may produce deafness by forcing air either into or out of the drum of the ear. In the summer of 1858, Mr. Tyndall was on the Fee Alp, in Switzerland, where, jumping from a cliff on to what he supposed to be a snow-drift, he came into rude collision with a rock which the snow barely covered. The sound of the wind, the rush of the glacier torrents, and all the other noises which a sunny day awakes upon the mountains, instantly ceased. He could hardly hear the sound of his guide's voice. This deafness continued for half an hour; at the end of which time a suitable act opened the Eustachian tube, and restored, with the quickness of magic, the innumerable murmurs which filled tha air around him.

"Light, like sound, is excited by pulses or waves; and lights of different colors, like sounds of different pitch, are excited by different rates of vibration. But in its width of perception the ear exceedingly transcends the eye; for while the former ranges over eleven octaves, but little more than a single octave is possible to the latter."*

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* Tyndall, op. cit., p. 75.

A knowledge of the transmission of sound through gases, liquids, metals, and the various kinds of wood, is of practical importance to the physician and physiologist. The subjoined tables are from the work of Tyndall:

VELOCITY OF SOUND IN GASES. FROM THE EXPERIMENTS OF DULONG.

(Temperature 0°C.)

	Velocity.
Air	1092 feet.
Oxygen	1040 "
Hydrogen	4164 "
Carbonic acid	858 "
Carbonic oxide	1107 "
Protoxide of nitrogen	859 "
Olefiant gas	1030 "

TRANSMISSION OF SOUND THROUGH LIQUIDS. (WERTHEIM.)

Name of Liquid.	Temperature.	Velocity.
River-water (Seine)	15° C.	4714 feet.
" "	30	5013 "
" "	60	5657 "
Sea-water (artificial)	20	4768 "
Solution of common salt	18	5132 "
Solution of sulphate of soda	20	5194 "
Solution of carbonate of soda	22	5230 "
Solution of nitrate of soda	21	5477 "
Solution of chloride of calcium	23	6493 "
Common alcohol	20	4218 "
Absolute alcohol	23	3804 "
Spirits of turpentine	24	3976 "
Sulphuric ether	0	3801 "

VELOCITY OF SOUND THROUGH METALS. (WERTHEIM.)

Name of Metal.	At 20° C.	At 100° C.	At 200° C.
Lead	4030	3951	......
Gold	5717	5640	5691
Silver	8553	8658	8127
Copper	11,666	10,802	9690
Platinum	8815	8437	8079
Iron	16,822	17,386	15,483
Iron wire (ordinary)	16,130	16,728	......
Cast-steel	16,357	16,153	15,709
Steel wire (English)	15,470	17,201	16,394
Steel wire	16,023	16,443	......

VELOCITY OF SOUND IN WOOD. (MM. WERTHEIM AND CHEVANDIER.)

Name of Wood.	Along Fibre.	Across Rings.	Along Rings.
Acacia	15,467	4840	4436
Fir	15,218	4382	2572
Beech	10,965	6028	4643
Oak	12,622	5036	4229
Pine	10,900	4611	2605
Elm	13,516	4665	3324
Sycamore	14,639	4916	3728
Ash	15,314	4567	4142
Alder	15,306	4491	3423
Aspen	16,677	5297	2987
Maple	13,472	5047	3401
Poplar	14,050	4600	3444

The tuning-fork is a familiar instrument with which we may produce an invariable note, its principal use being to regulate the tone of musical instruments.

It is composed of a U-shaped bar of steel, connected at its base with an axis or handle. This, when struck against anything solid or when a bow is drawn across either prong, gives a definite note by its state of intense vibration.

By some modern writers upon diseases of the ear, special importance is attached to this instrument as an aid in diagnosis.

VIBRATION OF AIR CONTAINED IN TUBES.

In wind instruments with walls of suitable thickness, the column of air contained in the tubes alone enters into vibration. The material of the tube has no influence on the pitch, but affects the quality in a striking and important manner, and the condition of the interior surface, whether rough or polished, or lined with cloth, has no effect upon the intensity of the sound. The shape of the tube has an important influence: if it be of the same size throughout, the sound will be simply condensed and strengthened by the reflections; if it be tapering, the angles will become more and more acute and the note deeper, the sound being increased; if it be conical, the apex receiving the sound and the base giving it exit, as in the speaking-trumpet, the angles will be less and less acute, until the last may be even obtuse.

The exact dimensions of each section of such instruments, therefore, becomes a matter of importance.

Tubes of wood, metal, glass, etc. are not merely conductors of sound, by preventing the rays from diverging and increasing their power by reflection, but the molecules comprising the instrument themselves vibrate.

These vibrations are in harmony with the sound introduced, but varying in their perfection.

It is evident, therefore, that if tubes prevent sounds from being lost in the air by expansion, they must conduct it to an almost indefinite distance; hence the great utility of hearing- and speaking-trumpets.

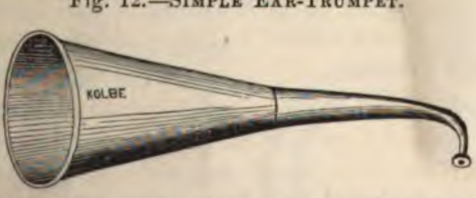
INSTRUMENTS TO ASSIST HEARING.

Ear-trumpets are to the ears what spectacles are to the eyes, but the aid which they render is neither as perfect nor as complete. Yet with all their defects they could not be dispensed with, as they are the only means by which deaf persons have intercourse with their friends, or are enabled to listen to a lecture or sermon; each individual generally has his or her favorite instrument, and would not part with it on any consideration.

Ear-trumpets are bent so as to cause the sound to be deflected from a straight line in passing into the ear; and by making the portion which receives the sound like a funnel, a much larger volume is received for the impression on the impaired auditory nerve.

The simplest form is seen at Fig. 12.

Fig. 12.—SIMPLE EAR-TRUMPET.



Those who are very deaf require a tube from fifteen to eighteen inches in length; those moderately deaf, one not so long.

In treating many deaf persons we must have a variety of

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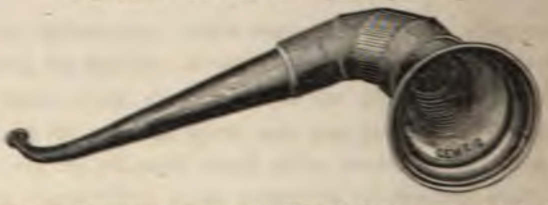
these useful instruments, so as to allow the patient to choose the one most suitable.

Mr. Isaac Williams, of this city,* manufactures trumpets of every variety to suit the various idiosyncrasies. He has a deaf workman, whom he at times employs to test the various trumpets.

Those sizes that are most used are from three and seven-eighths ($3\frac{7}{8}$) inches in diameter at the larger extremity, the curved tube in all being from twelve to fifteen (12 to 15) inches in length, terminating in a small acorn-like extremity, which can be made of tin, ivory, or silver, to fit the external ear.

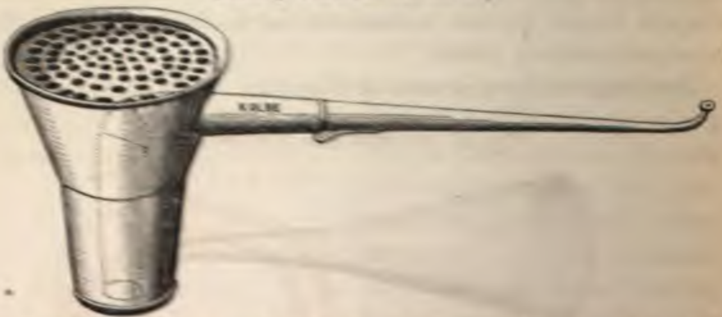
The tin japanned trumpet is seen at Fig. 13.

Fig. 13.—Ear-Trumpet (tin japanned).



The larger trumpet seen at Fig. 14 is one which has been employed by the Rev. Dr. Haswell and his son, the devoted missionaries to Burmah, who are both very deaf.

Fig. 14.—Haswell's Ear-Trumpet (to be had of Messrs. Kolbe and Gemrig, Instrument-makers).



They have employed this form after trying every variety of English and American hearing-trumpets. They prefer it because it allows several persons to converse with them at one time, whilst the large perforated part is turned towards them, and can catch every word distinctly; they have even heard the faint whisper of a dying man. Hence this form, apart from its size, is adapted to clergymen, and many very deaf persons have found it most admirable, enabling them to hear a sermon, lecture, or conversation.

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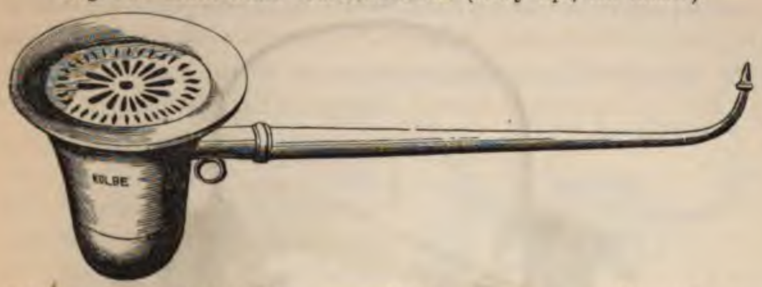
* They are to be had also of Kolbe and Gemrig, instrument-makers.

The next one, Fig. 15, is the original trumpet of Harriet Martineau, which is also a useful instrument, and much employed in England.

Fig. 15.—Martineau Hearing-Horn (ivory tips, ten inches).

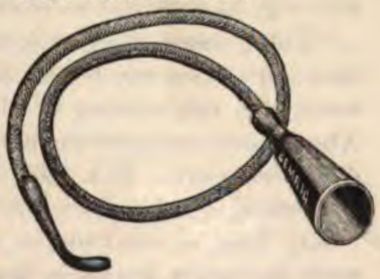


Either of the last-mentioned forms can be used in a church or lecture-room. They should be placed upon the floor or a stool, and the sound conveyed from them by being connected with a gutta-percha tube, which can be concealed in the clothing. The trumpet itself can be covered on its outer part with cloth or silk.

CONVERSATION-TUBES.

Sometimes the cores of the tubes are made of iron or copper wire, having a funnel-shaped arrangement at one end, and a small tip at the other. These are called "Conversation-Tubes;" the deaf person inserts the tip in his ear, whilst the funnel-shaped extremity is talked into.

Fig. 16.—Ear Conversation-Tube, made of silk or cotton on a wire body with horn tips.

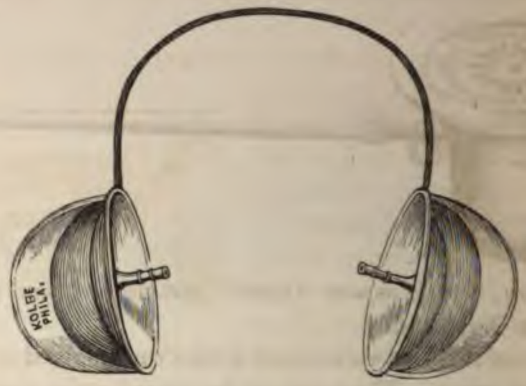


The conversation-tube illustrated in Fig. 16 is made of silk or cotton on a wire body covered with gutta-percha, with horn tips.

In speaking into all these instruments, it is of the utmost importance not to elevate the voice, but to speak distinctly.

The auricles invented by the celebrated Itard (Fig. 17) fit into the ears under a cap or bonnet, and can be covered with the hair; they are kept in place by means of a spring passing over the head. They have been found by some to be useful in listening to a general conversation or lecture; but very few can wear them long, on account of the rustling noise and the irritation they create in the external ear.

Fig. 17.



The following is the experience of one of my patients in regard to the use of auricles or ear-cornets:

"Having used ear-cornets or auricles for six or eight years, I can safely recommend their use.

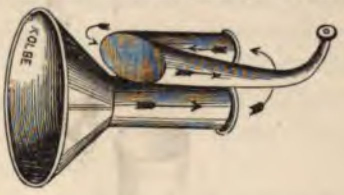
"These instruments are invaluable in shopping, in the transaction of business, and in social intercourse; as, by wearing them, those persons who are very hard of hearing will only be regarded as moderately so.

"The greatest drawback to their usefulness is that they cannot be worn any length of time, as they press upon and weary the ear, causing at times quite a painful sensation. About three consecutive hours is as long as they can prudently be worn. If a lady be the wearer, she finds it unpleasant at times to have her bonnet tied over them."

Any form of ear-trumpet should not be indiscriminately worn for use in the early stage of deafness, more especially those cases arising from debility or congestion of the nervous apparatus. In chronic cases, however, they often prove most serviceable. They are equally advantageous in cases of partial anchylosis of the stapes to the fenestra ovalis. The surgeon should determine, with the assistance of his patient, the proper form to be used, and not trust, as is too often the case, to the instrument-maker alone. He should take the same care in fitting his patient with an ear-trumpet as the ophthalmic surgeon does in fitting his patient with the proper form of eye-glass.

A smaller form, or pocket-trumpet, is seen at Fig. 18, which is capable of being taken apart and so arranged that it may be carried in the pocket. Many persons employ this kind abroad, as well as a large one at home; it has been found very useful for physicians. That form of ear-trumpet which Von Tröltsch has found to be the most useful for the greatest number of cases consists of a stranded leather tube, of a foot or more in length, with horn extremities. The end inserted in the ear should be about the size of the meatus, the patient holding it in or on this part. Similar to this leather ear-trumpet is one of pasteboard, which, for the sake of convenience, is made in sections, to be joined together when used. This form may be seen at No. 3, Fig. 19.

Fig. 18.—POCKET EAR-TRUMPET.



The otaphone consists of a silver clamp fitted to the posterior border of the auricle, which has for its object to cause the ear to stand out farther from the head, and thus make easier the reception of sounds.

To distinguish very low sounds, Helmholtz fitted a glass funnel into the ear with softened wax, and was very successful in this way.

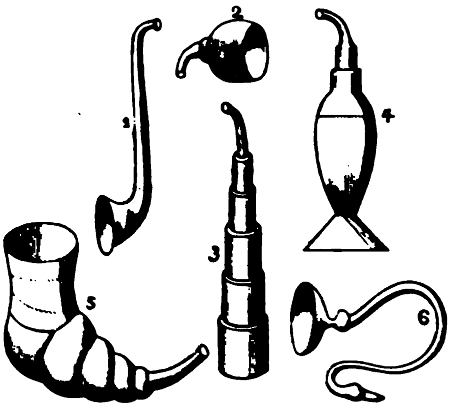
Patients living at a distance, who cannot come to the surgeon, by sending a description of the form of deafness, with a wax model of the meatus, can be furnished with an ear-trumpet accurately fitted.

The following illustrations, taken from a recent French work,* show, in a comprehensive view, the various forms used in France. The one mostly employed is seen at Fig. 19, No. 1. Another form much employed is that at (2).

Curtis has had constructed trumpets which draw out like a telescope (3).

Itard has indicated a series of other forms. The first is a sort of ellipsoid, furnished with a pavilion and curved tube, which sinks into the ear; the pointed ends are two membranes of goldbeater's skin, which, without augmenting the sound, render it less confused (4).

Fig. 19.



Another system is represented by (5). To realize it, Itard has taken a spindle-shaped shell, and to it added a little tube to fit the ear; also a pavilion, into which one could introduce, if wished, one or two membranes of goldbeater's skin.

Recently, Mr. Koenig has constructed an acoustic trumpet, which is at the same time a stethoscope (6). It consists of a capsule shut in by a communicating membrane, and is connected with the ear by means of a gum-elastic tube terminating in an ivory end.

When you speak before the membrane, the latter vibrates and pushes the column of air which is in the tube against tympanum of the ear.

The length of the tubes is four metres, and shorter when sound seems feeble.

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* L'Acoustique, par R. Radau. Paris, 1870.

CHAPTER IV.

TABLES OF CLASSIFICATION OF DISEASES OF EAR.

DISEASES of the human ear causing deafness are more frequent in the male than the female; this may be accounted for by the fact that the male is more exposed to the vicissitudes of the atmosphere. According to Sir William Wilde, of two hundred persons affected with deafness from disease of the ear, one hundred and one were males, and ninety-nine females. In France, Triquet states that, of the same number of cases, one hundred and twenty-six were males and seventy-four females. In the record kept by the author, of six hundred cases, there were three hundred and twenty-six males and two hundred and seventy-four females.

In Dr. Roosa's table it will be seen that in five hundred cases, including ten deaf mutes, the proportion was only two hundred and ninety-seven males to two hundred and three females. This discrepancy, in this country, arises from the present style of head-dress worn by the ladies in the street, which exposes the ear to every variety of temperature.

Cold, producing catarrh in its various forms and its consequences, is the predisposing cause of deafness in childhood, and throughout all the stages of life.

Diseases of the ear are often the result of constitutional disorders, as, for instance, the gouty, rheumatic, scrofulous, tuberculous, syphilitic, and cancerous. Age is also a frequent cause of deafness; and so good an authority as Von Tröltsch asserts that not more than one out of three persons from twenty to forty years of age possesses good and normal hearing. In our own investigations, we have found that the larger number of persons lose the hearing of one ear and sometimes both, and this we have found at all ages. About one-fifth of the cases of disease of the ear are hereditary or communicated from progenitors, many families having two, three, four, five, and even six members deaf and dumb;

this is owing to too close consanguinity of parents. Then follow, next in order as a cause, the exanthematous disorders, scarlet fever, measles, and smallpox. The other causes are mumps, quinsy, with acute and chronic inflammation of the throat, nasal passages, and middle ear. There is a form of deafness caused by intermittent, typhoid, and typhus fevers, in which the brain is the part usually affected, which, for want of a better name, we call nervous deafness.

A glance at the tables, compiled from various sources and our best authorities on aural surgery, will also serve to give a comparative estimate of the frequency of aural disease and the many forms it assumes, as well as the results of treatment, etc.

A TABLE

Of Six Hundred Cases of Diseases of the Ear, from Dr. Turnbull, occurring during 1868, 1869, *and* 1870, *Howard Hospital and Private Practice.*

	Male.	Female.	Whole No.	Cured.	Improved.	Unimproved.	Died.	Not treated.
Injured auricle	1	3	4	4	...	...	...	...
Foreign body in external canal . .	2	3	5	5	...	...	...	...
Eczema auriculæ, acute and chronic .	6	14	20	12	6	2	...	...
Inspissated cerumen	65	48	113	73	35	5	...	...
Furunculous abscess meat. ext. . .	18	12	30	30	...	...	...	...
Otitis externa	12	18	30	16	12	2	...	...
Otitis interna, pur. perf. (chronic) .	2	3	5	...	2	1	2	...
Catarrh, aur. media, acute, perf. . .	68	31	99	37	25	36	1	...
" " " chronic " . .	63	48	111	12	51	39	...	9
Otitis media, inflam. mastoid process .	18	17	35	10	13	8	4	...
" " chronic, with caries . .	6	4	10	...	2	6	2	...
" " syphilitica . . .	9	9	18	2	14	1	1	...
" " with polypi . . .	9	9	18	14	3	1	...	...
Periostitis, with abscess (cerebral). .	2	4	6	...	1	2	3	...
Neuralgia, plex. tymp.	2	3	5	2	2	1	...	...
Effusion of blood, memb. tympani .	2	1	3	3	...	...	...	...
" " " middle ear . .	1	1	2	1	...	1	...	...
" " serum " ". . . .	3	1	4	2	2	...	...	...
Cophosis nervosa, caused by concussion, typhoid, scarlet, and bilious fevers, etc.	5	16	21	...	2	19	...	...
Perforation membrana tympani by blow	3	1	4	3	1	...	...	...
Inflammation membrana tympani, acute	2	1	3	1	2	...	...	...
" " " " " chronic	18	19	37	11	13	13	...	...
" " of Eustachian tube . .	7	3	10	3	7	...	...	...
Deaf mutes	4	3	7	...	1	6	...	...
	326	274	600	241	194	143	13	9

It is only by estimating the causes and morbid conditions developed by unhealthy action that one can form just estimates of the probabilities of success in treatment. To aid in the formation of opinions, with reference to the results of treatment, the effect of location, etc., these figures have been obtained.

A view of the tables will show a great preponderance of chronic affections. Chronic catarrh and chronic inflammation of the membrana tympani are frequent causes of deafness, and to the student of these diseases the question naturally arises, how many of these cases of "dread silence," in this world of sweet harmonies, are the result of neglecting acute attacks that were manageable in their early stage, but, when seen by the aural surgeon, were, alas, too late for remedy?

A TABLE

Of Five Hundred Cases of Diseases of the Ear, from Professor Roosa.

	Whole No.	Cured.	Much imp.	Improved.	Unimproved.	Unknown.	Died.
Furuncular inflammation of external canal	8	7	...	...	...	1	...
Diffuse inflammation of external canal .	11	11	...	...	...	...	...
Eczema of external canal	5	4	...	...	...	1	...
Inspissated cerumen	46	42	...	2	1	1	...
Foreign body in external canal . . .	2	2	...	...	...	...	...
Simple acute inflammation of cavity of typm. (One side)	21	18	...	1	...	1	1
Simple acute inflammation of cavity of tymp. (Both sides)	13	11	...	2	...	...	...
Simple chronic inflammation of cavity of the tympanum	245	11	17	56	96	64	1
Acute suppurative inflammation cavity of tympanum. (One side)	8	6	...	...	...	2	...
Acute suppurative inflammation cavity of tympanum. (Both sides)	7	1	5	...	...	1	...
Chronic suppurative inflammation cavity of tympanum. (One side)	45	5	10	19	...	9	2
Chronic suppurative inflammation cavity of tympanum. (Both sides)	66	2	15	27	9	11	2
Diseases of labyrinth	9	...	...	...	...	9	...
Deaf mutes	10	...	...	...	...	11	...
Tinnitus aurium without deafness . .	3	...	...	...	...	3	...
Hysteria	1	...	...	...	...	1	...
	500	120	47	107	125	95	6

"The time required for treatment is a question that is worthy of consideration. Perseverance is the rule in almost all of the chronic forms of disease. And many that have apparently not been improved, by weeks of careful treatment, will suddenly commence to progress favorably, and eventually be much improved. To have abandoned them would have given a fine opportunity for some potent mystery to have gained the reputation of the cure."

Dr. Roosa gives, in the following table, the duration of five hundred deafness cases before they came under his observation. The figures are valuable, as they are obtained by a distinguished and accurate observer.*

One year or less	177	or	about	35	per cent.
Between one and two years	35	"	"	6·1	"
Three and four years	25	"	"	5	"
Four and five "	19	"	"	3⅘	"
Five and ten "	107	"	"	21	"
Ten and twenty "	82	"	"	16	"
Twenty and thirty years	36	"	"	7	"
Thirty and forty "	12	"	"	2⅖	"
Forty and fifty "	4	"	"	0·8	"
Fifty "	2	"	"	0·4	"
Seventy-five "	1	"	"	0·2	"

The results of treatment may be estimated by a glance at the following table, compiled from various sources:

AUTHOR.	Whole number.	Cured.	Improved and much improved.	Not improved.	Not treated.	Died.
Schwartze	322	145	122	31	111	3
Roosa (1870)	500	120	47 107	125	95	
Moos (chronic aural catarrh)	100	17	64	19	......	...
Clarke	140	62	31	14	33	...
Turnbull	600	241	194	143	9	13
Roosa (1871)	494	97	65 84	110	Unknown. 137	1

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* New York Med. Journal, Aug. 1869, page 513.

The following table,* from the Report of Diseases of the Ear, treated in General Hospital in Vienna, by Dr. Josef Gruber, during the year 1868, is of interest, for the sake of comparison. The completeness of this table will make it valuable.

DISEASES.	Remaining at the end of 1867.		Admitted.		Cured.		Improved.		Not cured.		Without treatment.		Died		Remaining at the end of 1868.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
EXTERNAL EAR.																
Freezing of external ear	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...
Othæmatoma	...	...	...	2	...	1	...	1	...	...	...	...	...	...	...	...
Eczema	1	1	1	5	1	5	...	...	...	...	...	...	...	...	1	1
Inflammation of mastoid process	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...
Atresia external auditory canal	...	...	2	1	...	1	...	...	...	...	2	...	...	...	...	...
Foreign bodies in internal auditory canal	...	...	1	8	1	8	...	...	...	...	...	...	...	...	...	...
Accumulation of cerumen	1	3	68	40	64	40	2	1	...	...	...	...	...	...	3	2
Circumscribed inflammation of external auditory canal	4	2	26	12	23	10	4	...	...	...	...	...	...	...	3	4
Acute inflammation of external ear	9	2	21	10	20	9	3	...	...	...	...	...	...	...	7	3
Chronic " " "	2	...	7	4	6	1	...	...	...	...	...	...	...	...	3	3
Acute inflammation of membrana tympani	3	1	16	4	13	2	1	...	...	...	...	...	...	...	5	3
Chronic inflammation of membrana tympani	2	2	5	8	4	6	...	2	1	...	2	...	...	...	...	2
Thickening of the membrana tympani	2	2	5	...	...	...	2	1	1	1	2	...	...	...	2	...
Loss of substance of membrana tympani	...	...	2	...	...	...	...	...	1	...	1	...	...	...	...	...
Rupture of membrana tympani	...	...	2	...	1	...	1	...	...	...	...	...	...	...	...	...
Cicatrices of membrana tympani	...	...	1	...	...	...	...	...	...	...	1	...	...	...	...	...
Abnormal deformities of the membrana tympani	...	1	6	2	1	1	3	1	2	...	...	...	...	...	...	1
MIDDLE EAR.																
Acute catarrh	9	6	35	21	30	20	3	...	...	...	...	1	...	...	11	6
Chronic "	23	22	90	52	25	8	40	32	5	3	13	5	...	...	30	26
" " with polypus	6	2	12	6	9	1	4	3	...	...	...	...	...	...	5	4
Contraction of Eustachian tube	10	5	4	2	...	...	4	2	...	...	3	2	...	...	7	3
INTERNAL EAR.																
Acute inflammation of internal ear	1	2	5	3	2	...	3	2	...	1	...	...	...	...	1	2
Caries and necrosis of temporal bone	1	1	...	2	...	...	...	1	...	1	...	...	1	...	...	1
Affections of labyrinth	17	16	37	34	2	1	5	7	6	6	18	19	...	...	23	17
Nervous earache	...	...	4	3	4	3	...	...	...	...	...	...	...	...	...	...
" tinnitus aurium	1	1	...	1	...	...	...	...	1	...	...	...	...	...	...	...
Deaf mutism	3	2	16	3	...	1	...	...	1	1	15	3	...	...	3	2
	95	71	368	228	208	118	75	53	18	13	57	30	1		104	80

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* Monatsschrift für Ohrenheilkunde, No. 9, September, 1869.

*Three Hundred Cases of Diseases of the Ear observed in England, compared with the same number seen in Germany by Kramer.**

EXTERNAL EAR.	ENGLAND.	GERMANY.
Catarrh of the ceruminous glands	9	46
Inflammation of the cartilage	4	8
Inflammation of the cellular tissue	1	1
Inflammation of the periosteum	0	0
Acute inflammation of the membrana tympani	1	2
Chronic inflammation of the membrana tympani	28	55
MIDDLE EAR.		
Catarrhal inflammation without exudation	0	2
Catarrhal inflammation with free exudation	7	10
Catarrhal inflammation with free and submucous exudation	9	29
Catarrhal inflammation with submucous exudation	239	143
Nervous deafness	2	4
	300	300

METHOD OF INVESTIGATING DISEASES OF THE EAR.

In order to fully comprehend the significance of symptoms and pathological conditions, some method in the order of investigation is necessary.

The following plan† is subjoined as a guide in investigating diseases of the ear. It is based, as far as possible, upon principles that have been established by practical observation and experience.

I. Name, age, and occupation of patient. Residence.

II. State of health, temperament, condition of pulse, etc.

III. If any relations are deaf.

IV. History of the affection: duration; discharge; sup-
d cause. Former symptoms: if at any time pain in
head. Nature of progress, whether rapid or slow;
ncreased by sudden paroxysms, or by imperceptible
Present symptoms: of pain, noises, or discharge;
of hearing power determined by watch, or as shown
ation; whether the patient requires to be spoken
in a room, or within the distance of a yard, or
ear; which ear is the worse.

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er and Politzer: Aural Surgery. Dr. Roosa: Boston Med-
l Journal.

n Toynbee.

Causes aggravating deafness: a cold, cold or moist weather, bodily fatigue, or mental excitement; the act of mastication. *Causes* producing improvement: improved health, dry air, cold weather.

V. Result of examination.

Right ear; left ear. The distance at which the watch is heard (the watch brought toward the ear). Ordinary distance in health is from three feet to thirty. Tuning-fork; conduction of sound through the bones. Patient's own voice; mode of speech.

Objective examination; auditory.

Meatus: quantity and condition of cerumen; state of the dermis of the osseous wall.

Membrana tympani: surface dull or shining, transparent or opaque; state of triangular bright spot; if more or less concave than natural.

Handle of malleus; catheterization and air-bath on hearing.

Eustachian tube: if air is heard, by means of the otoscope, to enter the tympanic cavity naturally during deglutition, the nose and mouth being closed; if the air is heard to enter the tympanic cavity naturally during a forcible attempt at expiration with nose and mouth closed.

Left ear ditto.

State of mucous membrane of the pharynx; condition of tonsils. General condition; hereditary tendency. Rhinoscopy. Examination of posterior nares and Eustachian tube.

VI. Previous treatment.

VII. Diagnosis.

VIII. Treatment.

DISEASES OF THE EXTERNAL EAR.

I. If ever troubled with erysipelas, and at what age in life?

II. If meatus ever closed, and the ear ever changed its natural form?

III. If ever affected with eczema?

IV. If a thin discharge exuded?

V. Is the external ear sensitive on pressure?

VI. If cysts were ever formed, and the ear disfigured by them?

VII. If there have been any tumors, and their cause? If carcinomatous, and their different stages?

EXTERNAL MEATUS.

I. If the membrana tympani be visible?

II. The diameter of the external meatus?

III. If the lamina of the membranes of the meatus are healthy?

IV. If the entrance of the meatus be protected by hairs?

V. Shape of the orifice of the meatus?

VI. If there be the natural projection of the tragus?

VII. If the meatus can be properly explored?

VIII. If any foreign body in the meatus? and its character by careful inspection? Symptoms of the patient at the time; whether cough or vomiting occurred, etc.; and whether there is giddiness or congestion in the head?

IX. Character of membrana tympani? (Its brilliancy.)

X. If ceruminous glands be normal?

XI. The color and nature of the substance discharged?

XII. The cause of its collection?

XIII. The symptoms when collected,—deafness, pain, crackling, or singing sound heard? if any inflammation by its presence?

XIV. If it caused any ulceration in the membrana tympani? whether there is inflammation of the dermis? acute or chronic?

XV. Result of examination: Character of discharge from the ear, and quantity? Causes of said inflammation? and if extending toward the brain? Whether there be simple chronic inflammation, or chronic inflammation of the dermis lining the meatus? The exciting causes? The state of health?

POLYPOID GROWTHS.

I. Their cause? Their position and attachment?

II. Whether there be a discharge? matter or blood?

III. Size of polypus by inspection?

IV. Whether any cerebral irritation?

V. Character and name of polypus?

OSSEOUS TUMORS.

I. Where situated?

II. Whether caused by rheumatic or gouty diathesis?

III. How large and how far in the ear they extend?

IV. Their appearance?

V. Whether they are painful on pressure or devoid of sensibility?

VI. Whether there is inflammation?

VII. If there be a discharge, and if offensive?

VIII. Whether there is deafness from their position?

IX. If the ear is distended and a sense of weight is experienced on the affected side of the head?

X. Whether the patient be of temperate habits?

MOLLUSCOUS TUMORS.

I. What part of the ear are the tumors located? Size and extent?

II. Whether they arise from the dermis? Do they enlarge rapidly?

SEBACEOUS TUMORS.

I. Where situated? Size?

MEMBRANA TYMPANI.

I. If in a healthy condition? Color, lustre, cone of light.

II. Character of its three layers? Inclination, curvature.

(*a*) Opacities of epidermoid; (*b*) dermoid; (*c*) substantia propria; (*d*) tendinous or peripheral opacities; (*e*) mucous membrane; (*f*) which tissue affected?

III. If any calcareous degeneration of lamina?

IV. Whether there is perforation? Size and form? If any artificial tympani would be of service?

V. If rupture of the membrana tympani? The cause of rupture? Situation, size and form.

EUSTACHIAN TUBE.

I. The anatomical character?

II. Whether obstructed in any way?

(*a*) If at its faucial orifice?
(*b*) If at its tympanic orifice?
(*c*) If in the middle part of the tube?

III. Causes of obstruction?

IV. If the Eustachian catheter has been used? and if of service?

CAVITY OF TYMPANUM.

I. Its anatomical character?
II. If mucous membrane congested?
III. If inflammation of mucous membrane?
  (*a*) Its causes?
  (*b*) If chronic inflammation or hypertrophy?
  (*c*) If catarrhal inflammation? and
  (*d*) Its extent?
IV. If ulceration of mucous membrane of tympanum?
V. If rigidity of tympanic mucous membrane?
VI. If anchylosis of the bones?
VII. If dislocation of bones?
VIII. If articulation is perfect?

THE MASTOID CELLS.

I. Anatomical character?
II. At what age diseased?
III. If necrosis of the mastoid processes?

NERVOUS DEAFNESS.

I. If nervous apparatus diseased?
II. Causes of the disease?
  (*a*) By concussion?
  (*b*) By application of cold?
  (*c*) Various poisons?
  (*d*) Typhus, typhoid, scarlet, or rheumatic fevers, measles, mumps, etc.?
  (*e*) Mental excitement?
  (*f*) Physical debility?
III. If any ulceration, caries, or necrosis?

MALIGNANT DISEASES OF THE EAR.

I. What part of the ear it occurs?
II. Its causes?
III. Constitution of patients affected with it?
IV. Hereditary influences?

DEAF AND DUMB.

I. Causes, as near as possible?
II. Condition of ear?

CHAPTER V.

ON THE MEANS OF DIAGNOSIS BY THE USE OF ARTIFICIAL AND DAYLIGHT FOR EXAMINING THE MEMBRANA TYMPANI AND AUDITORY CANAL — PREVENTION OF DEAFNESS — NOISES IN THE EAR, ETC.

A LARGE number of lamps have been employed as means of illuminating the ear, a few of which we will describe rather as relics of the past than for any good results to be obtained from them; strange as it may seem many persons prefer them to the more simple form which we now employ, as making more impression upon the patient. In 1741, Archibald Cleland, an English army surgeon, published in the "Philosophical Transactions" an account of "instruments proposed to remedy some kinds of deafness proceeding from obstructions in the external and internal auditory passages." The first of these consisted "of a convex glass three inches in diameter, fixed in a handle, into which is lodged a wax candle, which when lighted will dart the collected rays of light into the bottom of the ear." According to Wilde,* "to this apparatus Bozzini added a concave mirror, but without much effect." Deleau further modified it by placing a lighted taper between two concave mirrors; then followed the lamp of Buchanan, which was improved by Kramer, who substituted an Argand lamp for the feeble wax-light. Later came a number of portable ear lamps, one of which the author employed for a number of years, consisting of a box attached to which was an oil lamp and two metallic reflectors, one of which is set at an angle in the bend of a projecting arm, and throws a stream of light on the membrana tympani through a fixed tubular speculum inserted into the meatus, while the operator looks through a narrow tube containing two small lenses. Another form is that of Clark's, which has been modified by the late Mr. Toynbee by causing the funnel por-

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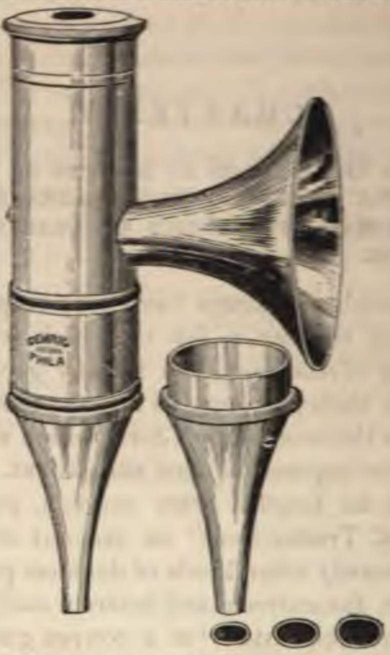
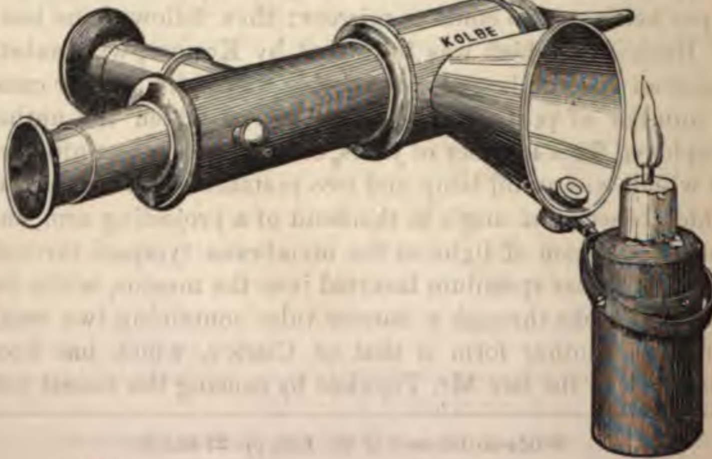
Wilde on Diseases of the Ear, pp. 27 and 69.

Fig. 20.—Toynbee's Illuminating Speculum.



tion to have a wider flange, and by adding to it a series of tubes which fit into the meatus ; this form is seen at Fig. 20.

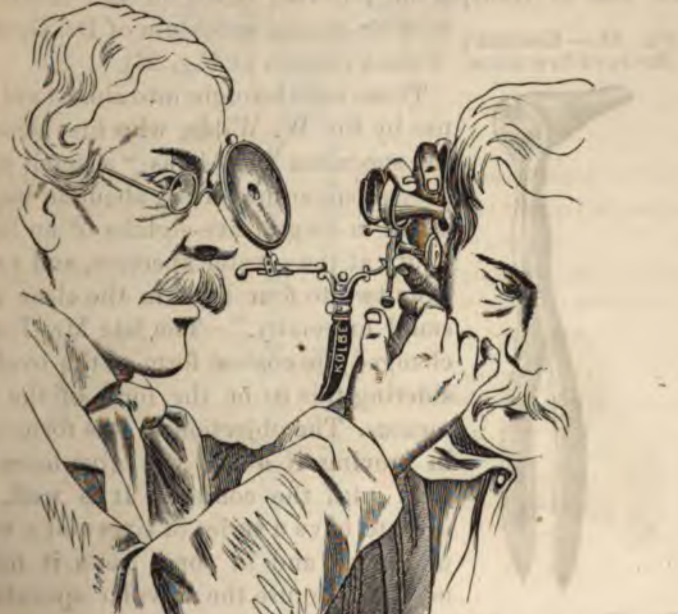
Fig. 21 —Hinton's Modification of Toynbee's Illuminating Speculum so that physician and student can both see at the same time.



Mr. Hinton, the successor of the late Mr. Toynbee, has again modified this speculum by fixing the candle to the funnel with a universal joint, and having a double tube and lens, adding three sizes of tubes for the ear. This instrument was brought for me by Dr. Gerhard during a recent visit to London, and it is claimed for it that when properly adjusted both physician and student, or friend, can see at the same time. It is shown at Fig. 21.

Dr. Weber has arranged a very neat little apparatus on the principle of the ophthalmoscopic mirror by receiving the light from the sun, or a flame on the mirror, which has a hole in the centre through which the operator looks. The light is reflected through a double lens, which, by concentrating the rays, makes the object more distinct, especially if it be minute. The small-sized speculum is supported by a ring attached to the instrument.

Fig. 22.—Weber's Reflector.



Another arrangement is where the mirror is attached to an elastic band, which holds it in position on the forehead of the operator. The light is placed above the head of the patient, and a small lens can be held between the light and the reflector. The objection to this is that the least motion of the head changes the cone of light, and this interferes with the focus. With artificial light we are able to detect a foreign body, an ulcer, granulation, or in some instances a perforation. But this is not as good as daylight obtained concentrated and reflected by the hand-mirror of Tröltsch, for with this alone can we detect slight shades of vascularity produced by inflammation or congestion, delicate opacities, minute points of morbid deposit, want of polish or loss of transparency, having fixed in the meatus the tubular conical speculum of Dr. Gruber of Vienna shown at Fig. 23.

Fig. 22.

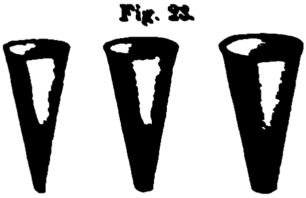
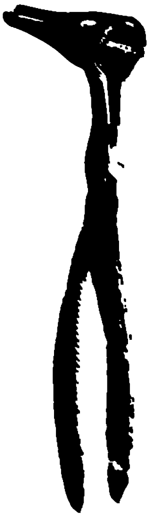


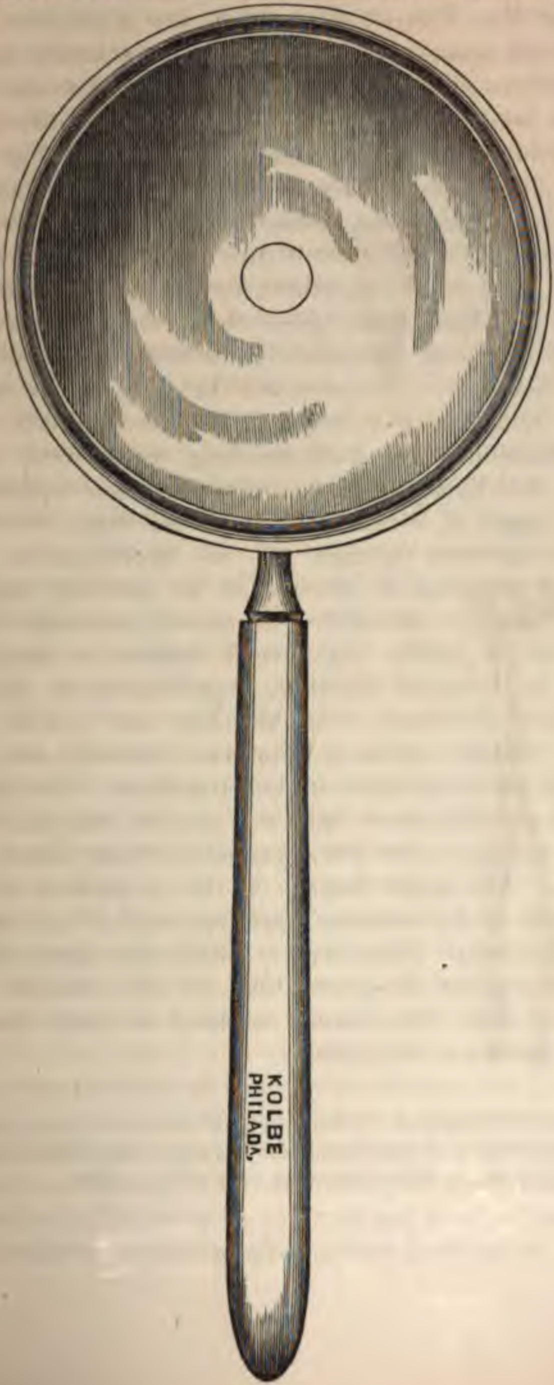
Fig. 24. Kramer's Bivalve Speculum.



These were brought into almost universal use by Sir W. Wilde, who first described the speculum in 1844 as "a small conical tube of silver measuring about an inch and a half in length, five-eighths of an inch in width at the greater aperture, and varying from two to four lines in the clear at the small extremity." The late Mr. Toynbee changed the conical form to the oval, considering this to be the form of the outer meatus. The objection to this form is that in moving it about you give more pain than with the conical. It is well, however, to have a series of sizes and a variety of forms, and in some cases it may be necessary to use the tubular speculum of [illegible] shown in Fig. 24.

[illegible] speculum being less [illegible] having a [illegible]. The conical form [illegible] practitioner when

Fig. 25.—Full-size Concave Mirror of Von Tröltsch.



only one set is desired; and should we add to this the concave mirror of Von Tröltsch (Fig. 25), before alluded to, we can examine the membrana tympani with great satisfaction even on a cloudy or stormy day, and in the evening we can employ a candle, lamp, or gas. The focal distance of this concave glass mirror is about six inches. It is seen at Fig. 25, full size. "The recent advance in our knowledge of aural diseases, which makes it a satisfactory field of study and practice, is due to the adoption of this method."* Dr. Politzer states: "The most important results in this department (that of the finer pathological changes in the membrana tympani) have been furnished by the thorough investigations of Von Tröltsch." He compared the observations made on patients by means of a very considerably improved method of examination with corresponding appearances on the cadaver, and showed from the unison between supposed and proven causes of disease how successful were observations of the membrana tympani for the determination of the nature of pathological changes in the auditory apparatus. Now it is well to remember the natural appearance of this membrane in health. "A normal membrana tympani, examined by reflected daylight, is a translucent pearl-gray membrane" (Politzer), with the head and handle of the malleus distinct—not very prominent, however, nor projecting much above the plane of the membrane. On the lower section is a reflection of light of a general triangular shape, its apex resting on the lower extremity of the handle of the malleus. The angle formed by the membrane with the upper wall of the external auditory canal is one of about 140°. (Tröltsch.)† This has been verified by numerous recent examinations, and it agrees with our own results. Of its deviations from this normal standard we have treated in another portion of this work.

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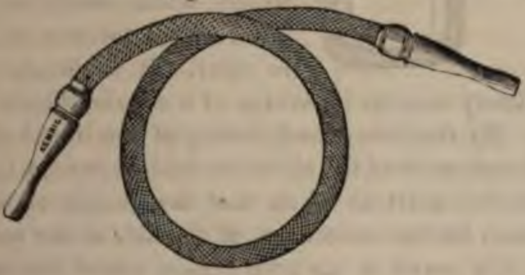
* Dr. Roosa, Transactions of New York State Medical Society, 1869, p. 226.

† The Appearance of the Membrana Tympani, Drs. Roosa and Berard, American Journal of Medical Sciences, April, 1867, p. 399.

ON THE MEANS OF DIAGNOSIS BY AUSCULTATION OF THE EAR.

The devoted and laborious investigations of Laennec were not only applied to the chest, but also extended to the ear. In his treatise he devotes an entire section to the auscultation of this organ; yet his stethoscope had many objections, being applied as it was over such an irregular surface as the external ear. This objection was overcome, however, by means of the flexible stethoscope devised by our lamented friend, the late Dr. Pennock, which, by the addition of two ivory tips, the late Mr. Toynbee made applicable to the diagnosis of diseases of the ear, and it is now called the otoscope (see Fig. 26), or diagnostic tube. It may consist of a simple elastic tube, or, better, one of coiled metallic wire covered with silk, gutta-percha, or worsted web, having ivory or bone tips, as in Fig. 26. Its use may be exemplified by placing one tip in the subject's ear, when in perfect hearing order, and the other in the physician's ear, when the patient is desired to close the nose and mouth and make a deep inspiration (or inward breathing), when the sound is heard of the *click* of the opening of the Eustachian tube.

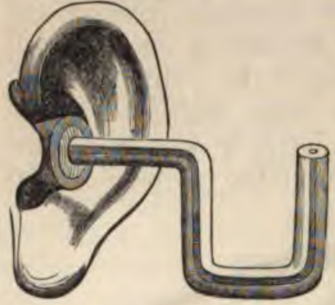
Fig. 26.—OTOSCOPE.



If, however, the ear is diseased, and we introduce the diagnostic tube, the patient can, by closing the nose and mouth and swallowing, cause the air to move, but not always to enter the Eustachian tube. If the tube be very moist it creates a vesicular sound; if more normal, the sharpness of the tone is changed; if very dry, we have more of a knocking sound, showing an obstruction; if the sides of the tube be relaxed, we have what may be described as a flapping sound, or the sound may be momentarily obliterated by the alternate collapse and dilatation of the tube; and in some instances no sound whatever is heard, owing to entire obliteration.

The Valsalvian experiment is performed with the little instrument seen in Fig. 27, which is placed in the external meatus. It will sometimes assist us in determining whether the Eustachian tube is open or closed. This instrument, also called the aural manometer, was suggested by Politzer, and consists of a horseshoe shaped glass tube 1½ mm. in calibre, which when used is partially filled with a solution of carmine in ether. It is firmly retained in the auditory meatus by means of a nozzle, which must be anointed. By the rising and falling of the liquid the variations in the pressure of the air in the middle ear are indicated. Care, however, must be taken that the motion of the jaw is not mistaken for the movement of the air, as the author has produced this result in his own person whilst the nose and mouth were closed.

Fig. 27.



If we have a very thin membrana tympani, there are the same sounds, with an increased pressure felt upon the membrana tympani of the listener; or if it is perforated, there is near us a whistling or loud hissing sound (the souffle). If the Eustachian catheter be now introduced, and the physician blows through it, the diagnostic tube still being in position, air may be forced into the middle ear by gradually and cautiously increasing the pressure. The position is indicated in Fig. 86: *a*, patient; *b*, surgeon; *ed*, the rubber diagnostic tube; *e*, the Eustachian catheter.

This pressure may be increased by using the caoutchouc bag of Politzer (Fig. 87) or the air-press, either large or small, which latter is seen in Fig. 32.

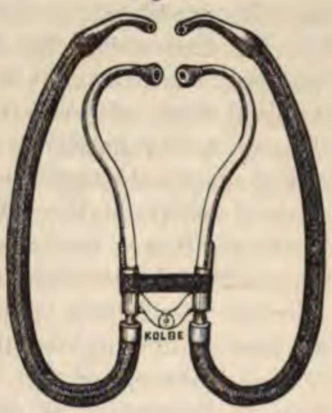
If a powerful stream of air pass through the Eustachian tube of normal size, and having a normal degree of moisture, it creates a sound which "Deleau likens to the falling of rain upon the leaves of a tree, and therefore terms 'bruit de pluie;' while Von Tröltsch calls it a vesicular murmur, or, if the force of the air be very great, a knocking sound, 'anschlage geräusch;' because we hear the stream of air striking a dry, elastic membrane, the drum, and pressing it somewhat outward."

Dr. E. Leudet* states that the involuntary objective bruits of the ear are rare. They may be muscular; at times they consist of a kind of crepitation and of crackling, and are identical with those which some persons can produce at will. The involuntary crackling bruit in the ear may coincide with a tic in the face, and seem to be caused by a rhythmical convulsion of the internal muscle of the malleus and chain of ossicles.

THE DOUBLE OTOSCOPE.

Having read in some of the German works of a double otoscope, but never having seen one, I have availed myself of a modification of the late Dr. Camman's double flexible stethoscope, which sometimes renders sounds distinct when they are scarcely appreciable with the ordinary instrument. It consists, as in Fig. 28, of two pair of tubes uniting so as to form one direct tube from the patient's to the surgeon's ears. The first pair are made of German silver, gently curved, and supplied at the aural extremities with ivory knobs; these fit securely into the surgeon's ears, and the tubes are firmly held in position by a band of india-rubber stretched across them. As they fit so accurately into the operator's ears, and are held

Fig. 28.



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* Gazette Médicale de Paris, No. 35; Half-Yearly Abstract of Medical Sciences, January, 1870.

there so securely, his hands are free. The other pair fit into the German-silver tubes, thus making them continuous. They are composed of rubber covered with silk, and likewise ending in ivory knobs, which fit accurately, and require to be held in the patient's ears. It is also supplied with an extra single tube, which may be used in one ear of the patient when the two are not wanted.

"With this apparatus the sounds are thus received through both organs of hearing and the faintest sound can be heard. With it we can determine the condition of the labyrinth, as patients are able to hear a tuning-fork placed on the median line of the vertex of the head better in the affected side than in the other.* Politzer says, in a letter to Von Tröltsch, that in cases where the patient is not able to state correctly in which ear he hears the tuning-fork most distinctly, he places both ends of a single otoscope (or diagnostic tube) in the auditory canals of the patient, and then the sensation is more decided.

"Lucae used for the same purpose a double otoscope made like the double stethoscope of Scott Allison.

"While the tuning-fork, which has been placed in vibration, is on the vertex of the head, or on the teeth of the patient, we may, by alternately pressing the two arms passing to the patient's ear, determine from which ear the tone is coming, and also distinguish the difference in its magnitude and clearness. Care should be taken that the tuning-fork is vibrating fully, and that the two ends of the three-armed tube are evenly placed in the meatus. The power of perceiving sounds through the bones is much less in advanced age than earlier in life. We can, therefore, draw no direct conclusion from a want of hearing the watch or tuning-fork after a patient is over fifty years of age.

"Lucae has recently described a new method of examining the organ of hearing, for physiological and diagnostic purposes, with the aid of the "interference otoscope." By this name he designates the double otoscope described above, but altered in such a manner that an india-rubber tube is inserted in it, which leads to a small metal sound-receiver of the shape of a half paraboloid. The latter is brought in front of a tuning-fork placed on an isolated stand, and this is struck by means of a small wooden hammer. By alternately pressing together one and the other tube of the double otoscope, we may decide how much the sonorous waves are reflected from each ear. This reflection of sounds increases in all changes in the sound-conducting apparatus, which either directly or indirectly cause an increased tension of the membrana tympani."

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* Von Tröltsch, Diseases of the Ear. American edition, p. 261.

THE PREVENTION OF DEAFNESS—COMMON HABITS INJURIOUS TO THE EAR AND CAUSING DEAFNESS—NOISES IN THE EAR, ETC.

First, children ought never to be struck (or boxed) on the ears, as injury to the membrana tympani, and even rupture, may follow; or deafness be produced by the sudden jar or shock, dulling the sensibility of the nerve. Teachers should always try a child's hearing before blaming it for inattention. This should be done by placing it a few yards distant and trying whether it can understand what is said to it in a rather low tone. Each ear should thus be tried by a watch while the other is stopped by the finger. The chief cause of deafness is cold. This is to be prevented by avoiding the ordinary causes, and by, first, taking plenty of fresh air; secondly, using cold water to wash the ears, neck, and front of the chest, and then rubbing the parts perfectly dry. Patients should avoid draughts, or sitting in wet clothes, or becoming overheated when in a close room and then passing suddenly into a cooler atmosphere: as from the church, school, concert, theatre, etc. Strong draughts are particularly hurtful to the ear, such as are caused by sitting close to the window of a carriage, car, or building. We should never let rain, sleet, or snow drive into the ear, as they also are very dangerous. Another source of danger is from keeping the interior of the ear too hot, by plugging the meatus with wool or cotton, or covering with hood, fur caps, etc., except in cases of great exposure, as when encountering a driving storm. "We* have known a case of deafness result from the placing of a piece of cotton in each ear before diving; the cotton disappeared and the patient was deaf for five years, and on examination by a physician he found both pieces of cotton firmly pressed against the membrana tympani, and covered with wax. In other instances there were found three separate pieces of cotton pushed down into the passage, where they remained, forming an obstruction to hearing." Pieces of paper are also rolled up and pushed into the ear. Almost all varieties of substances are placed there by children, as stones, grains of indian-corn, wheat, shells, etc. Their removal can always be accomplished by means of syringing with warm water, or the use of the curette. When such accidents happen, no attempt should be made with forceps or probes of any kind, with the exception of a strand of delicate silver wire, which can be employed by the physician, as if he were about to remove a cork from a bottle. It causes much less suffering, however, to the child, to employ the syringe, and also too much haste is thereby avoided. The reflux of the water should be depended on to wash the foreign body out; and this may require syringing for several days. Washing the ear out with soap and water is injurious, keeping the wax moist when it ought to become dry and scaly, increasing its quantity unduly, and collecting the particles of dust always floating in the atmosphere. Introducing the twisted up corner of a towel is particularly hurtful, as it pushes the wax down upon the membrane. Washing should not extend beyond the outer surface, and care should be taken that all the little folds of the outer ear be carefully dried with a soft towel. Another hurtful agent is a piece of sponge attached to a handle (the aurilave) to wash out the ear. This is saturated with water, and becomes an air-tight piston. If there is itching of the ear, a little glycerine introduced on the end of the finger will afford relief, and painting the parts with spirits of wine has been found useful. Earpicks, tweezers, etc. are to be condemned, as are also bodkins, pins, etc., as these may accidentally pierce the delicate membrane. Sportsmen sometimes have this membrane pierced by a twig, on turning suddenly, while getting through a hedge, and farmers often suffer from the introduction of the beard or straw of wheat or rye. Loud sounds, as the firing of guns and the ringing of large bells, etc., may produce deafness, as often occurs during a cannonade, and in some instances the explosion causes rupture of the membrane.

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* Graphic.

If an insect should get into the ear, pour in oil or glycerine; these suffocate it, when it should be washed out with a syringe. Boys sometimes injure the ears of their playfellows in snowballing; and bathing, although a very healthful exercise, is often injurious to the hearing, first, by staying too long in the water; second, swimming and floating are dangerous on account of the entrance of cold water into the ear or nose. No cold fluid ought to be allowed to enter the ear, and if water get in, the head should be carefully turned to one side and efforts made at once for its removal. It is, therefore, always safe, in bathing in the sea, to cover the head with some light material, as an oil-silk cap or straw hat tied over the ears. "That the risk to hearing from unwise bathing is not a mere fancy, we have proof in numerous cases of deafness from no other cause in man, and it is also proved by the fact, well known to lovers of dogs, that those animals, if in the habit of jumping or being thrown into water, so that their heads are covered, frequently become deaf. Wet hair will cause deafness, and it should not be left hanging about the ears of children, as for the purpose of curling."*

We now come to that cause of deafness which results from the desire to keep the ear clean. Nature has her own method of cleansing the ear by means of the ear-wax. In health this wax dries and forms thin, fine scales; these separate from the surface.

It is well, when subjected to violent concussions of air, to take the necessary precautions. Do not stand to the windward of a cannon or large gun, and always keep the mouth open. Furthermore, constant noises, as those made in a factory or foundry, ought, if possible, to be avoided.

It is a bad practice, when in pain, to introduce chloroform, hartshorn, hot oil, or grease of any kind; pieces of hot fig or onion should never be put in, but warm flannels should be applied with fomentations of hot water or poppy. If the pain does not soon subside, cotton charged with either of the volatile agents may be employed, being always surrounded by a dry piece of cotton that they may not cause much irritation.

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* Graphic, op. cit.

NOISES IN THE EAR, OR TINNITUS AURIUM, NERVOUS AND ACOUSTIC.

The ringing sound heard in the ears is not only a symptom of almost all diseases of the ear, but also a very troublesome indication of disease in itself, for after all apparent disorder has passed away, the patient is still distressed and disturbed by a most persistent form of noise, which, in some instances, is a form of mental malady. Tröltsch describes these sounds as a form of irritation of the auditory nerve, known by various names, and produced by quinine, blood diseases (anæmia and chlorosis), temporary and permanent hinderances to the circulation, functional diseases of the nervous system, and abnormal conditions of the ear itself, as we have before stated. More especially in all the conditions that increase the pressure upon the fluid of the labyrinth; but chronic catarrh is the most constant cause of tinnitus, either from mucus in a liquid or dried condition.

It is stated by Politzer, that spasmodic contraction of the tensor tympani is a frequent cause, and Tröltsch* speaks of a shortening of the tendon of the same muscle as a cause. In diseases of the semicircular canals, as described by Ménière, it is stated to be always accompanied by severe tinnitus. Concussions produce tinnitus; hyperæmic conditions of the naso-pharyngeal space cause this affection, also foreign bodies in the Eustachian tube. The author had under treatment a case caused by swallowing the beard of barley, which passed into the tube, causing otitis media purulentia, and the beard was ultimately discharged through the perforation. Dr. Cohen saw this case with him, and made a rhinoscopic examination, but was not able to remove the offending body in its early stage. The patient recovered under treatment, the membrana tympani healing perfectly and the hearing being normal.

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* Treatise on the Diseases of the Ear, p. 518.

Another case is related by Fleischmann as follows: "A man complained for years of a continuous sound in the ear, and of a very peculiar sensation in the pharynx, as though a hair had gottten into his mouth. On the post-mortem section, a grain of barley was found projecting from the pharyngeal orifice of the tube and reaching into the osseous."* Cold in the head is sometimes accompanied by temporary tinnitus, which after a time becomes permanent from repeated attacks, and this is always considered an unfavorable symptom. In cases where the venous sinus surrounding the carotid artery becomes ossified the pulsation of it is perceived in the ear, and the same occurs in the narrowing or aneurism of the artery.

Rayer† reports a case of pulsating tinnitus synchronous with the beat of the heart, which was perceived by others than the patient on auscultation, and which was momentarily checked by compression of the mastoid branch of the posterior auricular artery. Many persons are able to produce a crackling sound, which is one of the internal sounds of the ear, and, according to Politzer, results from the sudden drawing away of the membranous portion of the Eustachian tube, which occurs during the contraction of the tensor palati muscle. There is also a similar sound made by certain individuals in the act of swallowing, on the movement of the jaw, and there are also sounds which originate in the ear itself and adjacent structures. An inquiry into their sources and conditions is called by Dr. Jago Entacoustics.‡ One of the points of importance he insists upon is, that "a tinnitus aurium frequently finds its way to the labyrinth through the membrana tympani, and that the tympanic wall is liable to the adherence of a tenacious secretion, and it is the removal of this that relieves aural catarrh, and not the simple opening of the Eustachian tube." Another point is, that if the hearing remain good notwithstanding the tinnitus, he believes the nerve to be healthy, and that the membrane and ossicular chain are intact, and that the vessels at fault are situated in the innermost regions. In these cases he believes that the tinnitus rather subsides gradually than suddenly, though a pellicle of mucus may drop from the inner wall of the drum, causing sudden cure. Dr. Jago lays great stress on tinnitus depending upon the numerous arteries, the partial narrowing of the calibre of any one of which may produce a noise. He also makes this remark: If a *souffle* be produced in the temporal artery by a due pressure with the finger in front of the tragus, it becomes much louder if the meatus be stopped; and it may be taken as a safe rule that when deafness depends upon a cause as deeply seated as the drum-head, a *souffle* or vascular tinnitus from vessels lying external to this is not likely to be heard, and where no deafness exists such a *souffle* or tinnitus would be augmented in loudness on stopping the meatus; whilst a sound, issuing from a point more deeply seated than the bottom of the meatus, is not likely in any case to be rendered *appreciably* louder in this way.

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* Von Tröltsch, op. cit.

† Comptes Rendus des Séances et Mémoires de la Société de Biologie, 1854, p. 163.

‡ Entacoustics, James Jago, M.D., British and For. Med.-Chir. Review, No. 83, July, 1868, p. 225; Functions of the Tympanum, by the same anthor, British and For. Med.-Chir. Review, April, 1867; On Diseases of the Ear, p. 324.

At the Howard hospital, in the treatment of all the nervous cases we employ those agents which improve and build up the nervous system. Locally we use the oils of belladonna and hyoscyamus, by dropping in the ears. The truly acoustic cases require the air-douche charged with chloroform, ether, iodine, or carbolic acid. As we have stated, many of these sounds which distress the patient are from a diseased condition of the *naso-pharyngeal mucous membrane*, it being the seat of catarrhal inflammation. This we have been in the habit of treating by the use of a solution of common salt and an abundance of tepid water, by the means suggested first by Professor Weber, and made still more practical by Dr. Thudichum, of London. It consists simply of a portion of rubber tubing, attached to which is a weight of lead or glass (see Fig. 56), placed at the bottom of a pitcher containing a quantity of the fluid above described; and this is set on a shelf or held higher than the patient's head. The other end of the tube is armed with a nozzle which fits into the nostril of the patient. The patient then bends forward and the fluid passes up one nostril, across, and emerges at the other. There are some important cautions to be observed: first, the fluid must be of the temperature of the body (above 96°); second, the patient must breathe gently with the mouth open; and lastly, must not swallow, else the fluid will pass into the middle ear and cause the following results, well told by a patient in the following letter from

"FREDERICA, KENT CO., DELAWARE.

"MY DEAR SIR,—I find on using the 'nasal douche' as recommended by you, that it affects me somewhat unpleasantly. I find no difficulty in passing the water as directed from one nostril to the other, or back into the throat. On passing the water into the throat the Eustachian tubes apparently are also filled, and give the same sensations I have experienced, when a boy, in swimming, and which we used to call 'bubbles in the ear.' I cannot free my head of the water taken in for some four or five hours after using the douche. I then feel as if I had taken cold. My ears feel sore; pressing the tips of the fingers into the external ear causes a dull pain, apparently about the drum of the ear. This passes off in about twelve hours. . . . I am much more deaf than usual for some hours after using the douche. . . .

"Yours respectfully,

"DR. TURNBULL. J. R. H."

To this form of medication there are some other objections which have been made by Professors Roosa and Knapp, viz., that otitis media may supervene and perforation of the membrana tympani be caused by excessive sneezing, the result of the use of the douche; but no such results have followed the extensive use of this most valuable means employed by the author and others, in hundreds of cases both of ear disease and of ozæna with or without deafness. To those who are timid about using it on these accounts, we would recommend the posterior nasal syringe, which is considered by distinguished authority "as being simpler, more thorough, and pleasanter to the patient." It should be made of hard rubber, so that any kind of fluid may be used in it. (It is shown at Fig. 29.) The best astringents to be used are infusions of krameria and sumach, made from the bruised root of the former and the berries of the latter, or by dilution of the fluid extracts.

Fig. 29.—Posterior Nares Syringe.

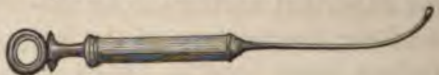
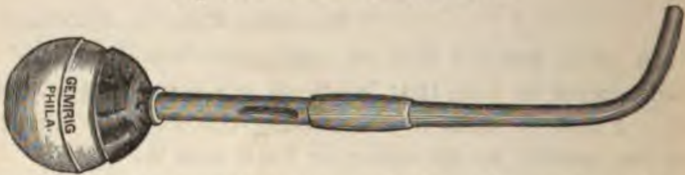
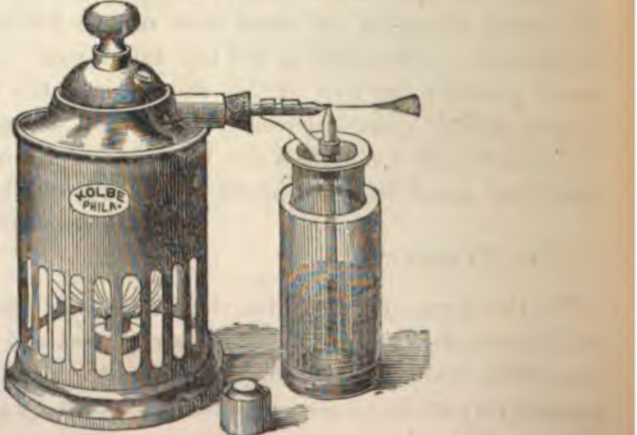


Fig. 30.—Powder Insufflator.



The author has used a warm solution of tannic acid or of alum with good results.

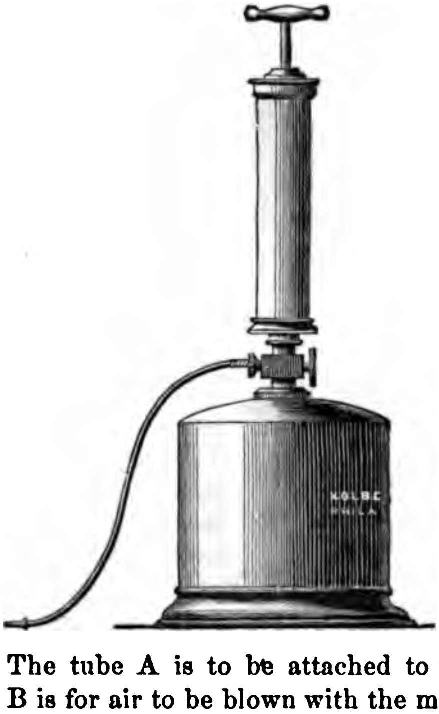
Fig. 31.—Steam Nebulizer.



If these means fail in chronic cases, employ the insufflation of powdered cubebs, tannic acid, or cinchona bark. The instrument for this purpose is seen at Fig. 30. The powder being placed in the opening, the sliding portion is pulled over it, and compression of the elastic portion by the thumb and finger forces out the powder in the form of a fine cloud. This can be alternated with the air-bag and catheter for minute portion of liquids.

If dry powders do not agree with the patient, then resort to the moist spray of steam (Fig. 31) charged with tannic acid, chlorate of potash, or chloride of ammonium (as seen in Fig. 33). By the air-press (see Fig. 32), the vapor of chloride of ammonium can be introduced into the middle ear, and is formed by the direct combination of hydrochloric acid, water, and aqua ammoniæ. In Fig. 33 the form of the apparatus is shown; also the proportion of each article is given on the bottles. The tube A is to be attached to the catheter, and the tube B is for air to be blown with the mouth, rubber bag, or air-press.

Fig. 32.—Air-Press.



There is another little instrument which has been found useful by some. It was devised by Siegle, and called by him the "pneumatic aural speculum." It acts by exhausting the meatus of air while the surgeon keeps his eye upon the membrana tympani, so as to see if it moves as a whole or in parts; those parts where it does not move indicating the spots where bands of adhesions occur in the tympanic cavity. We have employed this instrument, but as yet have not had much good to result from it. Mr. Hinton* states that "in this respect it has great value. It consists of a box whose external opening is very oblique and covered with glass; to this is attached an india-rubber tube, by which it is exhausted by the mouth or by a syringe. The lower part is of three sizes, and is greased and fitted into the meatus, and is joined to the upper part by a screw, and when in place the membrana tympani can be seen through it and its movements noted." The whole arrangement is seen in Fig. 34.

Fig. 33.—Apparatus for Generating Chloride of Ammonium (Muriate of Ammonia).

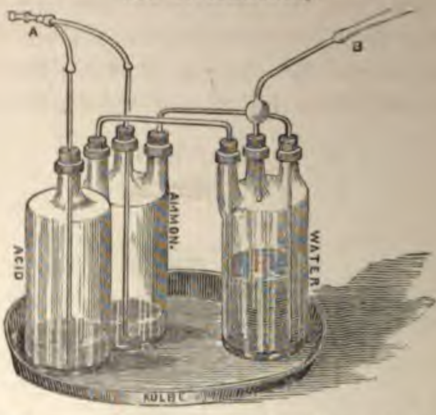
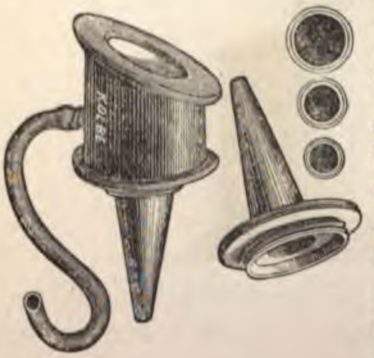


Fig. 34.—Siegle's Pneumatic Aural Speculum.



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* An Outline of the Present Method of Diagnosis in Aural Surgery, by James Hinton, Med. Times and Gazette, Aug. 10th, 1867.

Mr. Hinton has found this instrument useful by virtue of its power over some forms of tinnitus. That this affection very often has its source in an excess of muscular irritability, and other causes leading to an increase of pressure on the labyrinth, he cannot doubt; and the more because, in a large number of cases, slight traction on the membrane by means of this instrument allays it for the moment. Politzer does not speak favorably of the action of the narcotic internal remedies which have been recommended in cases of subjective noises in the ears; but he has, however, observed a very great abatement of the annoyance after the external application of a narcotic, either in drops or as an embrocation, and places no reliance on counter-irritants. Internal remedies have but little influence save in exceptional instances, such as cases of constitutional syphilis, which should be treated by iodide of potassium. An air-bath or pressure of the finger on the mastoid process relieves the tinnitus for a time. If there be catarrh of the nose and adjoining regions, employ Thudichum's douche, first with a solution of common salt, and, after the discharge has become thin and watery, employ a solution of alum (ʒi to warm water Oj), and if the discharge do not cease, use a solution of sulphate of zinc (grs. ij to ℥i of water).

Of the use of electricity in tinnitus we would refer our readers to the article Electricity in Chapter XVIII.

CHAPTER VI.

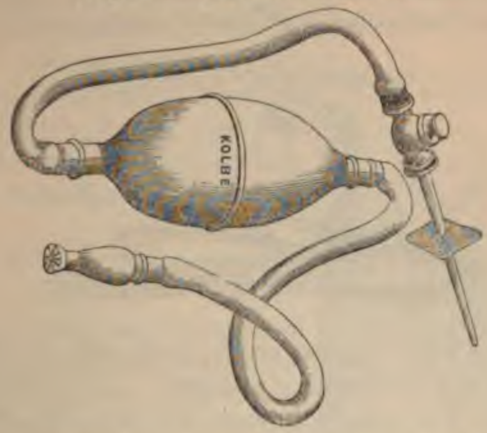
SYRINGING THE EAR FOR THE REMOVAL OF ACCUMULATIONS OF CERUMEN AND FOREIGN BODIES.

SIMPLE as this process may seem, and plain as the indications may appear, yet this operation has been greatly underestimated and much abused. It should be remembered that the patient cannot syringe his own ears with advantage, and the surgeon who relies upon the performance of the operation in this manner need not be surprised to find the results unsatisfactory to himself and annoying to the patient. As the use of the syringe is not unfrequently required, either for the removal of foreign bodies or morbid products and accumulations, we deem it proper to give a few general directions with reference to its systematic employment. First of all, we insist upon having a perfect instrument, nicely adjusted and working smoothly and easily, so that all irregularity of the stream may be prevented. The irregular impulse of a jumping, jerking, knocking stream is unpleasant to the patient. Various forms of syringes for washing out the auditory canal are furnished to the physician.

The modification of Davidson's syringe by the addition of a proper nozzle and shield, as shown in Fig. 35, has been found useful, in the practice of the author, for cleansing the ear and removing foreign bodies, and if the nozzle is bent at right angles can be passed behind the uvula.

Should the elastic syringe not be at hand, the form shown in Fig. 36 may be substituted. This instrument can be made of metal or rubber, as in Fig. 37, and the nozzle should be blunt and smooth. Sharp points and edges may injure the auditory canal, even when care is taken, and they should always be avoided. The nozzle or tube of the syringe should in all cases be narrowed so as to enter

Fig. 35.—Davidson's Syringe.



in readily, yet allow any foreign matter to pass to one side of it.

Fig. 36.—Cylindrical Ear-Syringe.

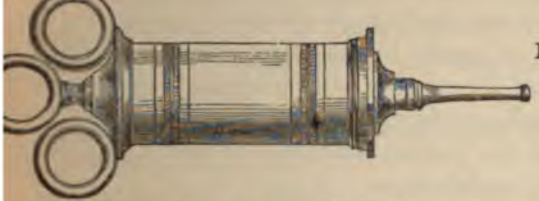
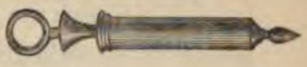


Fig. 37.—Rubber Ear-Syringe.



This syringe should hold at least two fluidounces, or, better, four, and the piston and rod should work smoothly and closely. The small nozzle should be so arranged as to be easily removed when the syringe is to be filled. Great advantage is afforded by the rings at the sides of the piston, as they furnish a means of having the instrument completely under control with one hand, while the other is left free to hold the ear of the patient, or for any other manipulation that may be required.

Prof. E. H. Clark, of Boston, has made a modification of Thudichum's (Weber's) nasal douche. Many years of successful practice and close observation of the needs of the aural surgeon give authority to his ideas. The instrument is described as follows:* "But simpler, better, and less costly than the syringe is an ear-douche which I have modeled after the plan of Thudichum's (Weber's) nasal douche (Fig. 38).

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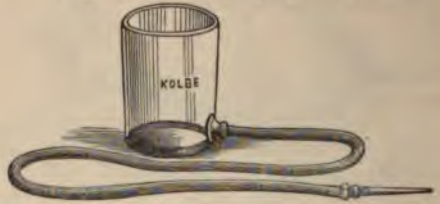
* Observations on the Nature and Treatment of Polypus of the Ear, p. 68.

Fig. 38.—Clark's Ear-Douche.

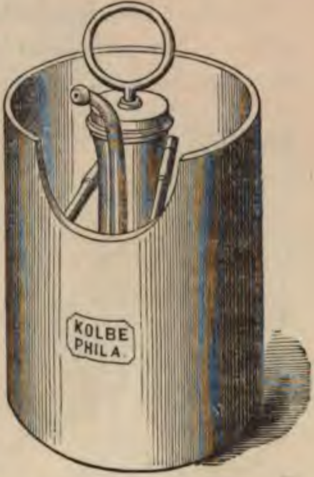


It consists of a jar of glass or tin, to the side of which, near the bottom, a flexible tube is attached. The jar holds about half a pint. The tube is three or four feet long, with an appropriate nozzle. In using the douche it is only necessary to fill the jar with the liquid to be used and to introduce the nozzle into the orifice of the meatus, and then raise the jar sufficiently high to force a current of the liquid into the ear. By this means a steady and continuous current is secured. It may be made forcible or gentle by elevating or lowering the jar. It cleanses the ear thoroughly and painlessly." This is probably the safest and best form of ear-douche that can be placed in the hands of the patient, and the one that will give the greatest amount of satisfaction.

The late Dr. S. P. Hullihen, of Wheeling, Va., invented an instrument to enable patients to perform the operation without assistance from another person. "It consists of a cylindrical metallic cup about three inches in depth and two and a quarter inches in diameter, with a semicircular piece cut out of its edge to adapt it to the ear, and a small metallic syringe of about half an inch in diameter. This syringe, in the first instruments constructed, was movable, and supported on two horizontal rods running across the cup, by means of which it could be made to slide forward or backward according to the will of the operator, but more recently the inventor has had it fastened permanently to the back part of the cup, thus enabling the patient to use it himself with more facility. The syringe has a large opening at the bottom covered by a valve, and the nozzle is made to come out from the side, near the bottom, and rising up to the top, is bent forward, so as to project toward the external meatus.

"Dr. H. has further improved the instrument by adding a narrow rim to the outer edge of that portion which is to be pressed against the neck immediately under the ear."*

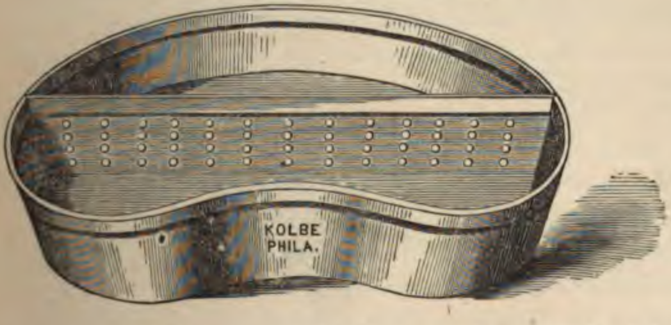
Fig. 39.—Hullihen's Ear-Syringe.



In the description of the instruments for cleansing the auditory meatus by means of currents of fluids, the means and precautions for protecting the patient and clothing must not be forgotten. Indeed, too much care cannot be given to neatness in these operations. A large apron of gum-cloth or oil-silk, fitting closely to the neck, is invaluable. A towel should be added to prevent any drops leaking, and thus soiling your patient's clothes.

Wilde's basin (Fig. 40) is of great service in these cases.

Fig. 40.—Wilde's Ear-Basin.



Its concave part fits accurately the curve beneath the lobe of the ear, and the perforated septum strains the clear water from the dirty.

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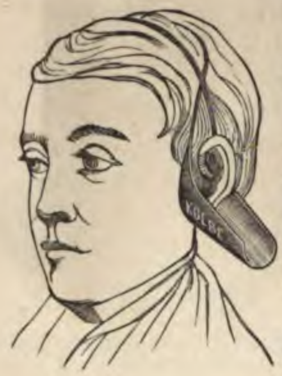
* Wilde on Diseases of the Ear, Philadelphia, 1853, p. 85.

If held by the patient in the proper position, closely applied to the cheek, no water can get down by its side. A small cup or bowl may be substituted, and requires to be held up, and closely applied by an assistant.

Toynbee's ear-spout is very serviceable. It consists of a spout-shaped piece held in position with a spring, which passes over the head. Its arrangement is best seen in Fig. 41.

Fig. 41.—Toynbee's Ear-Spout.



This has been modified by having a piece of wire attached to it, so that it hooks over the auricle and requires no spring to hold it in place (see Box, Fig. 116).

Having completed the arrangements for protection, after deciding that the case is a proper one for the use of currents of fluids, we should select one of the forms of syringes represented in Figs. 35, 36, 37.

Grasping the auricle with the left hand and drawing it slightly upward, outward, and forward, so as to straighten the auditory canal, we inject a steady stream of water into the ear.

In employing the cylindrical or gutta-percha syringe, the thumb should be used to elevate and depress the piston, whilst the fore and middle fingers are inserted through the stationary rings, and thus steady the syringe. In Davidson's syringe, the compression of the bulb will serve to graduate the force of the current.

Warm or tepid water should be always used, as cold fluids cannot be tolerated and ought never to be employed.

It is well to cleanse the ear of pus, etc. by removing as much as possible with small pieces of cotton on the point of a probe, or by a camel's-hair brush, or piece of lint; and should examination reveal a perforation or an ulceration of the tympanum, some other means than the syringe should be resorted to in cleansing the ear.

In syringing the ears of nervous persons or those having tender ears, it is well to fill the concha with warm water.

Mr. Wilde bears strong testimony against indiscriminate syringing. "I am induced," he says, "to make some remarks, in hopes of putting a stop to practices not only useless, but in some cases positively injurious. I allude to the common habit of syringing indiscriminately, and also of probing the ears without proper inspection of the parts. The former is of daily occurrence; thus, a patient laboring under deafness, or perhaps what is worse, violent pain in the ear, is examined, either without the assistance of a speculum, or by means of some of the old divaricating instruments, most probably in a badly-lighted apartment,—at all events, without the membrana tympani being brought into view, a dark cavity being all that the explorer is able to perceive;—it is deemed advisable to try what might come out by squirting hot water into this dark passage for a quarter of an hour or longer; but nothing satisfactory following this operation, the diagnosis that there is no wax in the ear is accordingly made.

"Now there may be a collection of cerumen, which may not be removed by this operation; while, if the cause of pain or deafness is owing to an inflammatory condition of the auditory canal and its membranous extremity, a decided increase of the symptoms is induced by this useless and cruel proceeding: and I have frequently seen inflammation produced by unnecessarily syringing an ear where no wax was present."*

At the Howard Hospital the author makes it a rule first to examine the ear with a speculum, aided by the sun or reflected artificial light.

If the canal is found to contain any soft living or dead morbid products, the assistant is directed to introduce a few drops of olive oil or glycerine by means of a pipette, and subsequently the ear is carefully washed out with an elastic syringe. If the substance be hard in character, as in cases of inspissated cerumen, a solution of bicarbonate of soda, grains five to ten to the fluidounce of water, is to be preferred. A teaspoonful of this solution is slightly warmed and placed in the ear for one or two nights previous to the operation of syringing.

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* Wilde on Diseases of the Ear, American edition, p. 87.

Simple as the operation of syringing the ear may seem, there are sometimes unpleasant results which could hardly be anticipated. We have seen syncope follow the injection of tepid water into the ear for the purpose of removing a foreign body.

Wilde states "that syringing, or the mere introduction of the speculum, induces at times violent paroxysms of coughing. In others the act of injecting tepid water will produce syncope, although the patients tell us that it is not from the pain they feel. The removal of a granulation, or a small polypus from the meatus, will at times produce sickness of stomach, weakness, and even fainting."

CHAPTER VII.

FOREIGN BODIES IN THE EXTERNAL AUDITORY MEATUS, AND THEIR REMOVAL.

THE orifice of the meatus is arranged as though nature had placed a barrier against the ingress of foreign bodies. The obliquity and curved direction of the canal presents another obstacle, while, in the adult, the bristling hairs pointing outward and covered with the bitter secretion of the canal prevent the entrance of insects.

The subject of the removal of foreign bodies from the ear is one of much interest to the profession, as they are constantly devising new methods, while the old and simple plan is always at hand in the use of the syringe and tepid water.

It not unfrequently happens, after the wildest outcry and alarm, on the supposition that something has fallen into the ear, that the most careful examination will reveal nothing, and as soon as the mind is disabused of the false impression, all symptoms of pain and distress disappear.

But if the bodies that get into the ear are not removed, they sometimes fill up the meatus and become lodged there, sooner or later producing unpleasant results.

Bodies with smooth, rounded edges are comparatively harmless, but those with angular surfaces and rough edges may produce deafness. The author has removed a grain of indian-corn from the ear of a boy, which had remained there unnoticed or had been entirely forgotten for four years; and although the hearing was improved, yet the long-continued pressure had permanently thickened the membrana tympani.

A medical friend related to me a rather curious case of a foreign body in the external meatus, which he saw at the

U. S. Army Hospital (South Street, Philadelphia), to which he was attached for a few weeks during his military experience. A young man was in the hospital, doing some duty about the place. He had the external meatus of one of his ears closed by a spent bullet, a convex section of which was visible just outside the commencement of the narrow portion of the meatus. The bullet had lodged there and become firmly impacted. The man declined having it removed, and the surgeon in charge of the case did not insist upon an operation, so that the case was shown to my friend and others as a curious exemplification of some of the vagaries of gunshot missiles.

This man the author examined as late as 1870, and found that he had a slight dark-colored discharge from that ear, but was not entirely deaf, and otherwise enjoyed good health. He was kneeling when he received this spent ball, which sank into the mastoid cells.

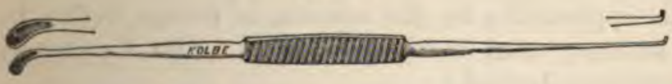
It is true that, in the above instance, a foreign substance remained in the ear for a long time without producing severe injury or but slight deafness; yet, in many others that have come under the author's notice, foreign bodies have given rise to inflammation of the meatus resulting in deafness; also to acute and chronic inflammtion, with thickening and perforation of the membrana tympani, followed by aural polypi, and even terminating in delirum, convulsions, and death.

The following is a list of some of the bodies which have come under direct notice, introduced either accidentally or intentionally: beads, shells, pins, needles, pieces of paper, wool, cotton, human hairs, bullet, pebbles, buttons, grains of corn, pieces of wood, straw, insects both dead and alive, etc. The means of extraction which have been, and are still, recommended in most works on general surgery and in our journals are not the most simple, but are rather complicated and often prove injurious, so that failure generally results, to the mortification of the physician.

For the comfort of those who have not succeeded in the extraction of a foreign body from the ear, it is stated that the late Sir Benjamin Brodie failed to extract a pea from the ear in a case which he relates in a report of a clinical lecture published in the London *Lancet*, January 6th, 1844: "There was a case brought into the hospital in which there was some foreign body, I believe a pea, in the external meatus. *I tried all sorts of methods to get it out.* I could not use the forceps, and it nearly filled up the meatus, so that the water injected could not pass behind it, or it was so jammed that the water injected by the syringe would not wash it out. I said let it alone, let it remain there, the pea in all probability will dry and waste of itself, and then it will come out, or when it is decayed it may be washed away with a syringe; but I will make no further efforts to remove it now, for I may drive it into the tympanum and kill the patient."[*]

The number of instruments which have been recommended by different writers are very numerous, such as hooks, scoops, curettes, etc. Professor Gross has invented an instrument which he believes will be found useful. It is composed of steel, is about five inches and a quarter in length, very light and delicate, cylindrical, and somewhat rough in the middle, to afford a good hold for the thumb and fingers, spoon-shaped at one extremity, and furnished with a little tooth or prong at the other. This tooth, which projects at a right angle from the shank of the instrument, is exceedingly small, and therefore admits of easy insinuation between the foreign substance and auditory canal. The curette or spoon is also very delicate, and bent considerably more than the ordinary cataract curette. (See Fig. 42.)

Fig. 42.



To facilitate the use of this instrument, chloroform is administered to the extent of entire obliviousness. This is absolutely necessary when the patient is a child or a nervous, excitable adult.* The objection to this instrument is, that it is made of steel, and, consequently, not being flexible, cannot be altered in shape to suit the circumstances of the case. I have seen and tried almost all the ordinary mechanical contrivances, and have arrived at this conclusion, that the syringe stands first in efficiency for the removal of all kinds of foreign bodies,—all other aids are secondary. This opinion is based upon many years' experience. It is the easiest and safest method, no matter whether the foreign body be large or small, light or heavy, irregular or even, occupying a small space or plugging up the meatus entirely, of recent introduction or of long standing. I have never failed with this instrument, alone, or in conjunction with a soft silver curette (Fig. 43), curved as seen in the cut; the flat end of which, as well as its shaft, can be accommodated to the varying conditions presenting in these cases.

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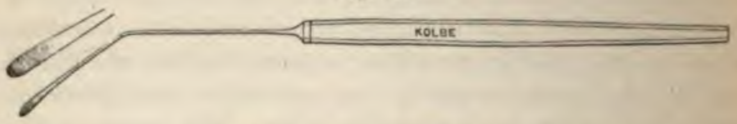
[*] See, also, a similar case in "Defects of Sight," by T. Wharton Jones, edited, with additional remarks on "Defects of Hearing," by the author, p. 177. Philadelphia, 1859.

Fig. 43.



The curette of Prof. Gross I find the best instrument for the removal of foreign bodies from the nose; but only secondary in cases of bodies in the ear. In two cases which occurred recently, one a bead and the other a button in the nose, I succeeded in removing them with this instrument.

The use of the syringe is not of recent application, but the credit of calling the attention of the profession to its universal applicability for the removal of foreign bodies from the auditory canal is due principally to Mr. Carpenter, of Castlecomer, Ireland.†

"The first case," he observes, "brought to me some years back, was one in which the foreign body was a garden-pea, which, as is usual, was pushed in as far as the membrana tympani by the interference of the child's friends. The instrument I selected was a very small forceps, with blunt points, with which I could catch the pea, but could not move it, and on endeavoring to do so, caused intolerable pain. It immediately occurred to me to inject cold water with force, in order to, at least, displace the pea. I did so with a two-ounce syringe, and found the pea so far displaced as to lie at the orifice of the meatus, whence I removed it without further trouble or pain to the child. Since that I have extracted many peas in the same way."

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* American Journal Med. Sciences, Jan. 1842, p. 231.

† Dublin Medical Press, June 10, 1841.

About six months after, Mr. Carpenter extracted a pebble, which was so irregular in shape and so large that he was surprised that the child could have borne to introduce it. The meatus was not inflamed, but the pebble was so far in and wedged in its place, that to touch it ever so lightly with any instrument was almost enough to throw the child into convulsions. The first injection failed; but while using a second, the pebble, much to his satisfaction, was forced out upon a napkin.

Dr. James Bolton* has related a case, interesting both in its history and result, which occurred in a girl aged thirteen years, "in whose meatus a grain of coffee had remained for seven years. He syringed the ear with warm water and Castile soap. On throwing in about the third syringeful, with some force, a black-looking substance shot into the basin, which, on examination, proved, beyond all doubt, to be the half of a coffee grain."

Mr. Edward Hatfield† removed from the ear of a boy by this means a piece of slate-pencil, which had been pushed farther in by the schoolmaster in a fruitless attempt to extract it.

Samuel Cooper‡ relates the case of "a child two years and a half old into one of whose ears a pebble and into the other a French bean had been pushed by another child, and remained there for ten months, causing complete deafness and extreme suffering." By throwing tepid water forcibly into the ear he soon dislodged these foreign bodies, which lay close against the membrane of the tympanum, entirely hidden by the swollen state of the lining membrane.

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* Medical Examiner for 1842, p. 613.

† New York Edition London Lancet, July, 1844, p. 97.

‡ Cooper's Surgical Dictionary, art. Ear.

Dr. J. Marion Sims* gives the following illustrative cases of the ease, safety, and certainty of this method of removing foreign bodies from the auditory canal:

CASE I.—A little negro boy, four or five years old, was sent to Dr. B. R. Jones, Montgomery, Alabama, with a piece of cut-glass in his left ear, and his master had made some fruitless attempts to extract it with a knitting-needle. The meatus was swollen, inflamed, and very tender. I happened to be at the doctor's at the time. We made many ineffectual efforts to get this substance out, using a bent probe, scoop, and forceps. We also used a syringe, but with a view of washing out some coagula of blood, the result of our awkward and clumsy poking with unsuitable instruments. The injury inflicted by our rude attempts at extraction was by no means trifling. After a second attempt on the following day with a pair of long, narrow-bladed, curved forceps with no better success, and just before giving the case over in despair to "bleeding and general antiphlogistic course," I picked up the syringe for the purpose of washing out a coagulum of blood that was hanging from the meatus. I threw in two or three syringefuls of tepid water, but the exuded blood still stuck there. I then requested Dr. Jones to take hold of the external ear and pull it outward, upward, and backward, so as to make the canal straight and allow me to see into the meatus. He did so, and I injected forcibly. My astonishment was equaled only by my delight at seeing the glass "ear-drop," as it proved to be, shoot out with great velocity. It was five lines in length, a little over three in width, and nearly two in thickness, slightly flattened on one side and oval on the other.

Its peculiar shape precludes the possibility of holding it between the blades of the forceps even now. Its size, in connection with the tumefaction of the meatus, shows that it must have been perfectly impacted, and I doubt very much whether it could have been removed at that time by any other instrument.

CASE II.—A little negro girl was sent by Dr. Hugh Henry,

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* American Journal of the Medical Sciences, April, 1845, pp. 340, 341.

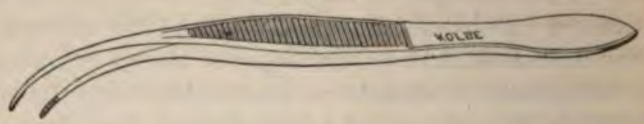
having a foreign substance in her right ear. It gave her some pain, but as there had been no useless and mischievous probing of the meatus, it was trifling in comparison with that suffered by Case I. I caught hold of the external ear with my left hand, putting it strongly on the stretch, so as to make the meatus a straight channel, while with the other hand I threw in a syringeful of tepid water forcibly against the tympanum. A single injection was sufficient to dislodge the foreign substance so far as to make it easy of access. It was a segment of a berry of the China-tree (Melia azedarach).

CASE III. was a negro man Lewis, aged twenty-eight, who had been deaf, with discharge from his ear from the presence of a cherry-stone, which was removed by the same means. It filled completely the bottom of the meatus, and was perfectly impacted and quite immovable, and from his history of the case must have been in the ear for more than *twenty years*.

I will only relate a few cases selected from many occurring in my own hospital and private practice.

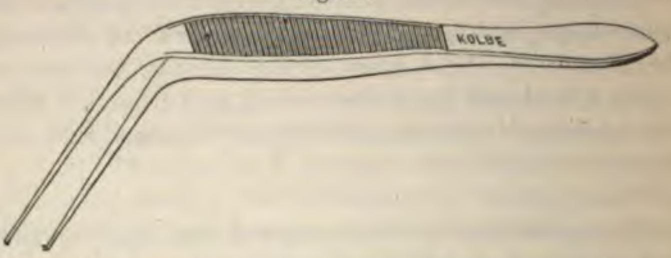
CASE I. *A button in the ear.*—June 7th, 1863, a physician brought to my office, in the afternoon, a boy aged six years, who had placed a gilt button in his ear about ten o'clock, A.M. His parents on discovering it took him to this physician's office, and he, after trying several forms of forceps, hook, probe, etc., found himself unable to extract it. He then called in a second physician, who, on examination, would not attempt its extraction for fear of doing more injury to the meatus, which was bleeding, swollen, and very tender. On examining with a speculum and bright light, I could discover the button on the membrana tympani, its eye being toward me in an upward direction, but bloody and flattened, so as to prevent my passing a hook into it. I therefore requested the physician to take hold of the external ear and pull it outward, upward, and backward. While he did so I injected forcibly a continuous stream of tepid water, which changed its position so as to bring it to that portion of the canal where I could seize it with a pair of forceps, which are shown at Fig. 42, a modification of Wilde's.

Fig. 44.



My only objection to Wilde's angular forceps is that they will not hold securely, being apt to slip; and they twist when much strain is put upon them, which they will not do as modified by the author. Wilde's forceps are seen at Fig. 45.

Fig. 45.



Case II. *Pebble in the ear.*—May 17th, 1864. Agnes R., aged five, whilst playing with pebbles from a sand-heap, placed one of them in her right ear. It remained there for some time, when she became alarmed, and upon inquiring of one of her companions "if it would kill her," was answered in the affirmative. She confessed to her mother, who became much alarmed, and took her daughter to the family physician, who tried to extract it. Owing to the child's restlessness and screaming, he only inflicted injury on the meatus without being able to extract it. On the 18th she was brought to Howard Hospital, and owing to her excited state it was considered best to place her under the influence of a mixture of ether and chloroform, recommended in such cases in 1859. On examination nothing could be seen but coagulated blood; but after the injection of tepid water, as before described, the pebble was washed out without pain or knowledge of the child. A soothing application was then applied to the ear, and the case discharged.

CASE III. *A grain of corn in each ear for four years.*—March, 1865. Robert B., aged six years, was brought to Howard Hospital by his mother on account of deafness in both ears since the age of two years. The mother could give no information in regard to the cause. It was not the result of cold, measles, or scarlet fever. On examination with a speculum and bright light, some foreign body was discovered in the ear, covering the membrana tympani. The parts were carefully syringed, and in one of the ears was found a mass of softened indian-corn. A second and even a third injection was employed, and a similar softened grain of corn was found in the opposite ear. The hearing was improved after some further treatment, but the membrane in both ears was rendered opaque from the pressure of the indian-corn for so many years.

CASE IV. *A grain of indian-corn in each ear for twenty-four days.*—Ann E. Moore, aged four years, residing in Norristown, Pennsylvania, was sent to me by Dr. W. R., with a grain of indian-corn in each year, which had remained in for twenty-four days. Efforts had been made by the physician to remove them by means of forceps, etc., but they only pushed them more firmly in, impacting them in the oval or ellipsoidal auditory canal. They were covered with dried blood, and the whole integument was swollen around them.

The child was in a highly irritated, nervous state, from the repeated fruitless attempts. With the assistance of her uncle, A. G. Feather, Esq., I placed the child under the influence of a mixture of ether and chloroform, and then, having the ear held as before mentioned, I injected forcibly several ounces of tepid water, and in a few seconds the water collected behind the body and washed it out, so that I could grasp it with my short angular forceps. The same result followed in the opposite ear, much to the delight of the mother and uncle of the child, who had witnessed the previous abortive efforts.

The child was then allowed to recover from the effects of the anæsthetic; the ear was carefully dried, and a portion of oil of belladonna was dropped in to remove irritation, and the case discharged.

Some bodies in the ear, more especially those that are rounded off and have no sharp edges, will do no harm; but there are many others which we know, from having witnessed the results produced, cause deafness, etc.

The following cases are from Toynbee,* and were treated by the same means:

CASE I. *Slate-pencil in the ear of a child.*—J. S., aged seven, was brought to me at the St. George's and St. James's Dispensary, on November 28th, 1849, her mother stating that she had pushed a piece of slate-pencil into the right ear. She had complained of pain, and had not slept well. Upon examination by means of a speculum and lamp, a rough piece of slate-pencil was observed lying on the floor of the meatus, one end being apparently in contact with the membrana tympani, while the other looked toward the orifice of the meatus. It was easily removed by the syringe and warm water, and found to be nearly half an inch long and a quarter broad. The patient did not complain of pain, and in a few days the membrana tympani was perfectly healthy.

CASE II. *A percussion-cap in the ear for fifteen years.*—C. E., aged twenty-six, was admitted at St. Mary's Hospital in November, 1852. She said that lately she had felt somewhat deaf in both ears. Upon examination a mass like hardened wax was observed near the orifice of the left meatus. It was removed by the syringe, and proved to be a percussion-cap surrounded by wax. The patient said that she remembered, when about eleven years of age, she put a cap into her ear, but she believed it had been taken out, and never thought of it since. The membrane of the tympanum was concave, the Eustachian tube natural, and the power of hearing nearly gone.

CASE III. From the same authority, showing the injurious effects from the use of instruments in removal of foreign bodies from the external meatus.

"A shell in the meatus; removal by instruments; paralysis of the portia dura nerve. Miss A., aged fourteen, consulted me in May, 1853, on account of deafness of the right ear, and paralysis of the right side of the face. Her father stated that, eight years previously, she had, in play, put a small shell into her ear; that the surgeon, in endeavoring to remove it, forced it deeper into the ear, breaking the shell, and causing intense pain. After its removal there was much discharge from the ear, and in a few days the muscles of the right side of the face lost their power, which they have not regained. Upon examination there was no vestige of the membrana tympani; the mucous membrane of the tympanum was very thick and red, and there was not the slightest power of hearing."

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* Cases of Foreign Bodies removed from the External Meatus, p. 71.

As an agent to assist the syringe in the removal of a shell from the ear, there can be nothing better than a delicate bent wire. By this means shells have been removed with great facility at Howard Hospital, by hooking the bent wire into the opening of the shell; but when they are flat, the reflex stream of water brings them near enough to be seized with a pair of angular forceps.*

The author is confirmed in this opinion by the most distinguished aural surgeons of the present age, namely, Wilde, Toynbee, Tröltsch, and Hinton.

In cases where the foreign body is irregular or ovoid in shape and fixed firmly, the plan of Jonathan Hutchinson, F.R.C.S., may be adopted.

He has applied the principle of removing a cork from a bottle by a string. The string, in this case, when employed in the ear, is a silver wire of five or six strands, in the form of a loop. This will be less apt to do any injury than the forceps, scoop, etc.

"I have a horror of the use of the scoop [so has the author] so generally employed, because it can only act as a sort of lever, and because I have repeatedly known it to do much damage. We have," Mr. Hutchinson observes, "a specimen in the museum, in which a bean was, by its agency, thrust through the membrana tympani, and produced death by its irritation."

The forceps are little better.

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* Transactions American Medical Association, 1865, p. 429.

Another method of removal is proposed by A. G. Brown, by atmospheric pressure (suction), by means of a few inches of French vulcanized rubber attached to an ear syringe so as to produce a vacuum.

The following was treated by Dr. James Collins, of this city:* F. A., aged five, was presented by his mother, who stated that while at play he had inserted a pebble in his ear, which could be plainly seen at the time, but had been pushed in more deeply by attempts to remove it, made by herself and other members of the family. The child was quite peevish, and complained of pain in the ear. On examination found the auditory canal swollen, and the surface covered with dried blood. A syringeful of tepid water, gently applied, removed this, when there was seen, deep down in the canal, a foreign body, white, hard, and easily recognized as a pebble. Chloroform was administered, and the plan suggested by J. Hutchinson, F.R.C.S., in such cases, adopted for its removal.

After gentle manipulation, the loop of a fine silver wire was passed around the body, and by gentle traction the pebble was removed without difficulty. The ear was filled with warm water, which was allowed to remain several minutes. In two days all pain and swelling had disappeared. The pebble was ovoid, and weighed four grains.

ASPERGILLUS IN THE AUDITORY CANAL.

Under the head of foreign bodies in the auditory canal the peculiar vegetable parasite *aspergillus glaucus* may be mentioned. The presence of these parasites produces irritation and inflammation. They accumulate, forming a lardaceous mass.

Dr. Robert Wreden,† of St. Petersburg, in a description of six cases of the affection, thinks they simulate inflammation of the external auditory canal, and the appearance somewhat resembles deposits of cholesterine. The micro. scope, however, exhibited no cholesterine, but on the contrary numerous long mushroom tubes with roundish spores. The auditory canals were half filled up with the white lardaceous mass. This was removed by forceps after syringing had failed. The epithelium of the membrana tympani and canal was found to have been removed, the cutis was dark red, and the malleus and light spot on membrane not visible. There was, of course, loss of hearing, and tinnitus aurium, dependent upon the closure of the canal and pressure on the drum.

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* Med. and Surg. Reporter, Philadelphia, vol. xx. No. 16, p. 308.

† Archiv für Ohrenheilkunde, 1867.

Mayer reported a case of the same in 1844.

Pacine observed and reported a case in 1851.

Schwartze observed this affection in 1865. He supposes that it is probable that exudation, inflammation, etc. of the canal occurred before the appearance of the mushroom-like growths.

In the year 1870 Dr. Roosa* reported two cases, and has collected those noticed above. Three cases have since been treated by Dr. J. O. Green, of Boston, and from his experience, a thorough repeated removal, with the use of water, is sufficient to kill the growth.

Dr. Robert Wreden, of St. Petersburg, has subsequently added eight cases, making fourteen in all, and has published a monograph on the subject.†

"There is hardly a doubt, as observed by Roosa, that an affection of the ear caused by the 'aspergillus' has existed for a long time, if not always; but it has not been recognized for the simple reason that diseases of the ear have been, until within a few years, very much neglected, except by isolated practitioners. Since his attention has been turned to the subject, and in this I quite agree with him, he could recall obstinate cases of inflammation of the auditory canal which contained this growth."

The subjective symptoms of the growth of "aspergillus" in the auditory canal are very similar to those from impacted cerumen. There is a sensation of fullness, tinnitus aurium, vertigo, pain, and impairment of hearing. Pain is not one of the common symptoms of inspissated cerumen, although it does sometimes occur. This may be due, as before stated, to the inflammatory action which always precedes the growth of this fungus. The subjective appearances consist in the adherence of flakes or scales of what may be mistaken for epidermis, on the walls of the canal and the outer surface of the membrana tympani. It requires to be removed by the forceps, and the integument beneath is found reddened and sensitive, and in a few hours the growth reproduces itself. In one variety little black points are seen in the mass, but it requires the aid of the microscope to confirm the diagnosis. The aspergillus flavescens and nigricans, as well as the stamphyllium polymorphum, have been found in the auditory passage. In regard to the etiology, Dr. Wreden says, "All these varieties of aspergillus are only varieties of the ordinary mould fungus."

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* Am. Jour. Med. Sci., Jan. 1870, p. 105.

† Die Myringomyleosis Aspergillina. St. Petersburg, 1868.

The etiology of this disease is no doubt owing to inflammation and deposit of fungus upon the surface prepared for it by the inflammatory action.

The following is the record of a case from Roosa:

CASE I.—"Was consulted by Mr. S., aged fifty-one, on account of impaired hearing, vertigo, pain in the ears, and tinnitus aurium. Vertigo was the symptom upon which the patient laid the most stress, and of which he was most anxious to be relieved. He said that he was so dizzy whenever he attempted to walk about, as to be unable to attend to his ordinary business. His condition in other respects was excellent. Patient stated that he had heard perfectly well until two months since, when he was attacked with the aural symptoms narrated above, which had been aggravated since their inception. He had been treated by the instillation of oils and so on. He could hear my watch about one inch on the right side and not at all on the other. Both auditory canals were found filled with a tenacious material which could only be removed by the forceps. It was several days before I could remove the firmly-adherent coating to the canal and membrana tympani.

"The morbid product was immediately examined by Dr. Lewis, and found to be a specimen of the *aspergillus* *flavescens.* Its removal gave the patient great relief, but on the reappearance of the growth, which was in two or three days after its removal, the vertigo and tinnitus returned.

"The membrana tympani was intact, but lustreless and rigid. The Eustachian tube opened sluggishly, and there was all the evidence of aural catarrh, besides the affection of the canal and the outer layer of the membrane of the tympanum.

"The free use of warm water, with an astringent, finally subdued the morbid process in the canal so that the patient was able to make a journey to the South. When he left the doctor's care, October 18th, the auditory canals were entirely free from abnormal secretion, the hearing was improved so that the watch was heard from five to six inches on the right side (thirty inches normal distance), and from one to two on the left. The dizziness was entirely gone, and the tinnitus ceased to be annoying. The catarrh of the inner ear, as shown by rigidity of the membrana tympani, sluggish action of the tubes, and impairment of hearing, still continued."*

MEANS TO PREVENT A REPRODUCTION OF THE PLANT.

Roosa, Green, and Knapp agree that the repeated removal with the use of water (warm) is sufficient to kill the growth. In the monograph of Wreden a long list of agents is given which may be found useful. Some of these are alcohol, bichloride of mercury, acetate of lead, tincture of iodine, and carbolic acid. He gives the preference, however, to the hypochlorate of lime (calcaria hypochlorosa), which he recommends to be used of the strength of one or two grains to the ounce of water at each application. Fowler's solution of the arsenite of potassa ranks next to the lime.

The writer prefers in such cases the hyposulphite of soda or the bisulphite, having found them both useful as antiparasitic, both animal and vegetable. The solution is made with water alone, or in combination with carbolic acid and glycerine in the proportion of three to five grains to an ounce, employed warm.

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* American Journal Medical Sciences, op. cit.

In connection with this subject it is well to notice that maggots are sometimes found in the external meatus. The following case, reported by the late Dr. R. P. Thomas,* will serve as an illustration. "He says that while a lady was standing under a tree, a small fly (probably a common maggot-fly) darted into her right ear, and remained there, in spite of all efforts at extrusion, for fifteen or twenty minutes. Eight hours later a sensation of motion was experienced in the ear; at first faint, but afterward more distinct, and increasing in violence until her powers of endurance were tried to the utmost. Forty-six hours after the ovi deposit was made his attendance was requisite. Her agony from this motion and waving sound in the ear was indescribable. The external meatus proved to be unusually narrow and deep, and therefore rendering an examination with the otoscope unsatisfactory. Having detected a tremulous jelly-like mass on the tympanic membrane, he attempted its removal with an ear-scoop but failed. A resort was then made to injections of strong soapsuds, and in a few minutes a maggot crawled out far enough to be visible, and thus determine its character. Removal by mechanical means without injury to the delicate membrane was impossible, and chemical solutions strong enough to affect their vitality, were deemed hazardous to the same structure. Sweet oil or almond oil will generally float out a bug or other small insect that may stray accidentally into the meatus, but their efficiency in removing parasites that have the power of attaching themselves to an animal membrane being deemed questionable, he resolved finally upon trying a solution of grs. xx of tannin in an ounce of pure glycerine. The reason for its employment was twofold, viz., for exclusion of the air from their breathing-pores by the glycerine; and the probability that the violent effect of the tannin upon the delicate surfaces of the parasites would cause such a degree of activity as would bring them in reach of the forceps.

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* Am. Jour. Med. Sci., January, 1861.

"The result confirmed the anticipation, and twenty-three maggots, each three-eighths of an inch in length, were removed by a slender pair of forceps in the course of a few minutes. The relief was immediate and complete, in two or three hours the cerebral excitement was allayed, and the following day the patient was entirely free of all uneasiness. Several months have elapsed without manifestations of any injury to the ear or the sense of hearing from the accident."

CHAPTER VIII.

POLYPUS OF THE EAR.

According to the best authorities,* both ancient and modern, polypus is understood to be a fleshy tumor, various as to color, form, structure, and consistence of tissue. But there is one common characteristic connecting all varieties of polypi: they all originate and develop themselves upon the mucous margin of the natural orifices,—nose, pharynx, rectum, neck of the uterus, and auditory meatus. It is with this view that authors define polypus of the nose, of the ear, etc. "The membrane of the auditory canal," says Boyer, "has an analogy to the mucous membranes, and, like them, is subject to polypous excrescences." "The name of polypus is given to an excrescence developed upon the tegumental membranes."—Polypi are commonly considered as peculiar to the mucous membrane, yet certain parts of the skin sometimes present excrescences exactly similar to the polypi, as the entrance to the vagina and to the auditory canal.† But the definition which especially applies to the nasal polypi, for which it was created nearly two thousand years ago, is not applicable to polypi of the ear. Triquet,‡ in his work, states that polypi of the ear are nothing else than a sort of fleshy excrescence which originate and develop themselves upon the external and internal membranes of the ear, when affected by chronic and puriform discharges, in the same manner in which we see the inflamed surface of old issues and ulcers sometimes covered with exuding and bleeding flesh, etc. There is nothing similar met with in the etiology of the polypi of the nose; not so, at least, if we are to credit the descriptions given by our best writers. Thus they confound two diseases which have really nothing in common but the name, and consequently introduced into practice a deplorable abuse, that of subjecting both diseases to the same treatment. The important differences which, in a few words, Triquet has just pointed out, seem to indicate another plan to be pursued. The ancient authors,—Hippocrates, Celsus, Galen, Ætius, and Paulus Ægineta,—in treating of the polypus, in many passages of their works have intended to be understood as speaking only of polypi of the nose. Thus Hippocrates,* in a few words, describes three varieties of the polypus which develop themselves in the nasal cavity. Celsus says, "Polypus verò est carnicula quæ narium ossibus inhæret:" "the polypus is a fleshy excrescence which attaches itself to the bone of the nose." According to Paulus Ægineta, "Polypus is an excrescence, the roots of which extend into all the points of the nasal fossæ." Such is the tradition which we find reproduced by the surgeons of the Middle Ages,—Guy de Chauliac, Pigray, etc.† But polypi of the ear are not contemplated in their works. We thus arrive at the sixteenth century, represented by A. Paré,‡ who had already perceived that "la fluxion tombée aux oreilles qui fait apostème, engendre ulcère hypersarcorse ou chair supercroissante. Et plus loin, quand cette chair est fort profonde, elle ne se peut guérir."—"It is true that a concise and very suggestive phrase is thrown in, as it were, by chance, into a chapter only known to contain a few theoretic views of deafness."

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* Historical Observations of Ancient and Modern Authors, from Triquet.

† Dictionnaire de Médecine, art. Polypi.

‡ Traité pratique des Maladies des Oreilles, p 309.

To Fabricius de Hildenis§ we owe the first positive case of polypus of the ear scientifically treated and reported. That case has been imperfectly quoted by all writers subsequent to him, and as it has been the theme of the dogmatical descriptions published since his time, I deem it indispensable to transcribe it accurately.||

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* Hippocrate, Œuvres complètes, trad. par E. Littre.

† V. Guy de Chauliac, Le Maître en Chirurgie, p. 392; Pigray, Epitome Chirurgie, p. 428.

‡ Œuvres complètes, édit. de Malgaigne, t. ii. p. 601.

§ Cent. 3, obs 1 (anno 1604).

|| Traité pratique des Maladies de l'Oreille, t. ii. p. 26.

"CASE I. *Scirrhous fungus protruding from the ear.*—In 1594 a young girl of noble family, Marguerite de Martines, was attacked, at the age of eight years, by the smallpox. The eruption was scarcely perceptible. A year afterward (1595), she felt violent pain, with no less violent shootings in the right ear. A few days later an abscess opened in the meatus, and the discharged matter resembled the offscourings of flesh. Very soon that discharge became yellow, and, after intermitting, it at length established itself permanently, but the pain no longer existed. Five years later (in 1600), the parents, having remarked that the hearing was weak on that side, had the curiosity to examine the diseased ear, and were surprised at finding that it was completely obstructed by a fleshy excrescence (excrescentiam quamdam carnosam). The discharge still continued, but as the noble patient showed a great repugnance to surgical operations, her family hesitated to call in the aid of art.

"It was not until the winter of 1604 that the parents consulted Fabricius.

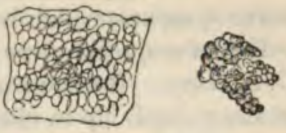
"The fungus excrescence, of which he has left us many designs in his fine work, had the form of the canal; that part which protruded from the ear was irregular, hard, livid, and spreading upon the concha by several muriform tubercles. The operation was appointed for the return of fine weather, and Fabricius employed the ligature on the 23d of May, 1604, to compress the lower part of the tumor. It came away on the third day, but its roots were only destroyed by the aid of numerous cauterizations, and the case was not complete until toward the month of August in that same year, 1604. In other words, the treatment lasted three months."

Having removed a number of these foreign bodies, the author most fully agrees with the conclusions arrived at by Triquet, who has collected some fifty cases from Fabricius de Hildenis, Leschevin, Scultet, Itard, Kramer, Toynbee, Pelletan, Sédillot, etc. From the Triquet practice, in every instance, there was a discharge before the polypus was known to be in the ear. Secondly, in no instance was there perfect restoration of the function of hearing. Thirdly, if the polypus was situated near the membrana tympani which was almost always more or less destroyed. Fourthly, the most successful treatment was the extraction of the polypus and cauterization. Fifthly, there are three varieties, vascular, gelatinous, and fibrous.

The following is an account of eight cases of polypus of the ear occurring in the author's practice:

CASE I. *Vascular polypus of the left meatus; epithelial of Clarke; extraction; otorrhœa; recovery.*—December 31st, 1857. George M., aged thirty-five years, by occupation a shoemaker, a native of Ireland, was suffering from entire loss of hearing in the left ear, with tinnitus aurium. The patient was of sanguine temperament, with scrofulous enlargement of the glands of the neck. On cleansing the ear by the use of the syringe and warm water, a vascular mass of polypus was discovered, like a strawberry in form, situated about one-half the distance from the membrana tympani. As it was soft, and bled on the slightest touch, I was unable to use the wire ligature, and therefore resorted to the lever-ring forceps of Toynbee. The patient sat on an operating-chair, and the light of the sun was made to shine directly into the ear, which was drawn backward by an assistant so as to dilate and straighten the meatus as much as possible. A large-sized speculum was next introduced, and then, with the right hand, the lever-ring forceps were gradually pushed down to the polypus with the rings in contact. As soon as the rings reached the polypus, they were allowed to separate, and when thus apart were made to surround the growth; when this was effected, the rings were brought into contact by pressing the lever.

Fig. 46.—EPITHELIAL OF CLARKE, AND VASCULAR OF TRIQUET.



The instrument was then withdrawn, bringing with it a part of the polypus.

January 2d. The small portion which remained in the ear resisted the use of astringents and caustics, and was entirely removed by a second operation.

Afterward the hearing distance of left ear was four inches;

membrana tympani opaque. Directed use of iodine externally and internally.

January [illegible]. Still improving, and otorrhœa less. January 16th, discharged, cured.

CASE II. [illegible] loss of the external [illegible] tympani; obstr- [illegible] —H. W. [illegible] M. C., aged eighteen, a student, was [illegible] October 17th, 18[illegible], a distinguished medical [illegible] who had himself removed [illegible]. Since then it had so increased as [illegible]. He was deaf, and the discharge [illegible]

[illegible] Made an attempt to remove it by using Wilde's [illegible] the bleeding [illegible] the ear with [illegible] applied several times, [illegible]

[illegible] mass by means of the [illegible] so profuse as to [illegible] plugging the [illegible] near the membrana [illegible]

[illegible] fever in the [illegible] return [illegible]

[illegible] —M. G., [illegible] ear, with [illegible] ex- [illegible] polypus, which was removed by the ring-lever forceps. Directed a tonic, with astringents, which removed all remaining traces of it.

The hearing was improved by pursuing this tonic course for several months.

All the foregoing described polypi were of the vascular character, and racemose in form, attached to the central stem or root. They were covered by tessellated epithelium, and when examined microscopically were found to be made up of soft, fibrous cells, very vascular, and which were easily broken, and found filled with blood and serum.

Some polypi are very small, as in the last case recorded, whilst others are so large as to fill up the entire meatus, and even project from the orifice. They are, as a general rule, attached to the inner half of the tube.

CASE V. *Soft gelatinous polypus on the left meatus for ten years; extraction; recovery.*—Mrs. R. L., aged fifty, the wife of a medical bookseller and publisher of this city, consulted me, December 4th, 1864, on account of a persistent discharge, with deafness so great as not to hear the tick of the watch. This she had suffered from for years, and applications had been made of various kinds, by advice of her family physician and others, without any benefit except of a temporary kind.

Her general health is good, but she is of a bilious, nervous temperament. On examining the left ear there was seen, deep in the tube, which was very narrow, a pale-colored polypus, attached to the walls of the meatus, filling up and assuming more of a globular form as it approached the meatus externus.

She did not wish any operation, and I attempted to remove it with caustic potassa, nitrate of silver, etc., but was not successful. After a time she consented. To give as little pain as possible, I removed it with a ring forceps in small portions. By the use of powdered alum, and other mild astringents, the discharge entirely ceased after a treatment of five months. Her deafness in that ear still continued, but she was entirely relieved from the offensive discharge, has no pain in the ear, and has had no return of the polypus.

CASE VI. *Fibro-gelatinous polypus; otorrhœa; removal; recovery.*—November, 1867. Mrs. C. A. R., aged thirty-eight, dressmaker, was sent to Howard Hospital (August, 1863) by her physician. She had suffered from the age of six years from deafness, and more or less discharge, following scarlet fever, but within the last year she has been unable to hear with the right ear, owing to a polypus that had grown so as to protrude outside the ear, the odor of the discharge being so offensive as to interfere with her business; even when sitting at rest, the discharge was so profuse as to pass under her chin and on her neck. On examination, the polypus was found somewhat abraded, and was attached about the middle of the meatus. I therefore resolved to remove it with Wilde's snare, which is the best instrument for the removal of this variety of aural polypus, and which is briefly described on page 124. The patient was seated on a chair with a good sunlight; in this case it was not possible to use the speculum. The cross-bar was pushed forward, and a noose made of the wire at the small extremity, of sufficient size to include the morbid growth, which it was made to surround and press down by means of the stem; the cross-bar was then drawn up smartly to the handle, giving it a single twist, which drew it up from its attachment without cutting it across. Bleeding took place, but by syringing the canal with cold water it was checked. On examination, it was found entirely removed. The patient did not return, but upon making inquiry of her physician, he sent me the following note:

"PHILADELPHIA, November 6, 1867.

"DEAR DOCTOR,—I called to-day on Mrs. C. A. R., and learned from her that, previous to the operation, her hearing was completely obstructed. Since the operation by you her hearing has very much improved, accompanied at times, from taking cold, by a slight discharge, though no appearance of another polypus. With this hasty sketch, believe me to be,

"Yours truly,

"LEWIS S. SOMERS.

"To Dr. TURNBULL, 1208 Spruce Street."

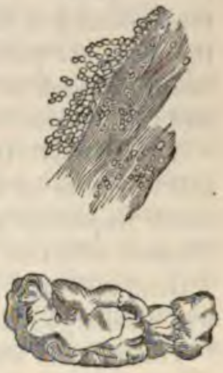
Under the microscope the interior of the gelatinous polypus is composed of corpuscles and fibrous tissue, proving that the name fibro-gelatinous polypus is the proper one.

No escharotic produces much effect upon fibrous tissue, so that extraction is the best method of removal.

CASE VII. *Large fibro-gelatinous polypus of Toynbee; fibrous of Clarke; otorrhœa; removal; recovery.*—Ann R., aged sixteen, applied at Howard Hospital, August 12th, 1867. She was suffering from pain and discharge, and noise in her ear. On examination, the ear was found very much distended by one of the largest polypi which I have removed. Her statement was, that a similar one had filled up her ear, and had disappeared of itself, but that this one had remained to her distress for six months. It was removed with the snare. The bleeding was very profuse, requiring the use of the persulphate of iron and plugging of the meatus.

The hearing in this case was improved, and the discharge stopped. The form of the polypus is seen at Fig. 47 much reduced in size by being in alcohol for two years. The microscopic appearance is also shown.

Fig. 47.



Mr. Hinton has stated that, as far as his experience goes, polypi in the meatus invariably spring from the dermis, though they also have attachments to the walls of the meatus.

CASE VIII. *Vascular polypus in the left meatus; loss of membrana tympani; otorrhœa; both Eustachian tubes closed; removal; recovery.*—August 15th, 1856. William J. M., aged twenty-eight; otorrhœa in both ears; had scarlet fever at the age of sixteen. Could only hear the tick of the watch when applied over the temporal bone. Both Eustachian tubes closed.

He is bent almost double with rheumatism. Right ear, membrana tympani entirely gone. Left ear filled up with a polypus, covered with yellow pus, which flowed out over the edge of the meatus.

Treatment.—Ten grains of iodide of potassium three times a day, with a wash of zinci sulphatis, ten grains to the ounce, to be dropped into left ear.

After cleansing with cotton, nitrate of silver was applied to the growths by means of Wilde's caustic-holder. Finding, after several trials during August, not much reduction in size, I twisted off portions at three different sittings. I applied powdered alum and then nitrate of silver to remove what was still at the bottom, but found it did not entirely destroy the spongy granulations, after eight months' persevering trial.

February, 1857. Applied a saturated solution of chloride of zinc on a piece of cotton, by means of the speculum, producing contraction of the granulations, so that I could see the membrana tympani, and an orifice from which the whole mass seemed to have sprouted. When I touched the surface of the mass, the patient felt a disposition to cough. His general health is much improved, he is now able to straighten himself, and the rheumatism is gone.

March, 1857. Dilated Eustachian tube by means of catheter and warm air at intervals of two weeks; his hearing was so much improved that he could hear me speak to him at a distance of six or seven feet.

Gradually the membrana tympani closed over, and he was discharged cured.

The case is one of great interest, and shows the good results to be obtained by persevering efforts, assisted by the willing help of the patient and the use of constitutional remedies.

"The truth probably is, that neither sex, age, nor general health of the individuals whose cases we have considered had much to do with the polypi in their ears. They sprang up in consequence of local causes, and grew because they found appropriate soil.

From Dr. Clarke's table, eight of thirteen growths appeared in the left ear, and five in the right ear. It is not fair to infer from this that the left ear is more likely to give birth to polypi than the right one.*

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* Observations on the Nature and Treatment of Polypus in the Ear, by Ewd. H. Clarke, M.D., pp. 32, 33. Boston, 1867.

It would require a very large number of cases to justify any such conclusion. It is probable that they may occur indifferently in either ear. Such, I think, is the common opinion of observers. The inquiry as to which were the earliest symptoms is an important one. We learn from this same table* that in one instance tinnitus aurium was among the earliest symptoms noticed; in six cases otalgia appeared early; in two or three cases tenderness and swelling were mentioned as among the first indications of difficulty. In all of them otorrhœa was referred to as appearing early; this was the history in all of our cases. Whatever else existed,—pain, tenderness, swelling, and noises,—a discharge from the ear was always one of the first warnings, and sometimes the first and only warning, of impending evil.

"These growths were attached to various parts of the external meatus; more of them to the middle than to any other portion. The auditory canal of the adult is about one and a quarter inches long. Suppose this, for convenience, were divided into three equal parts, called the outer, middle, and inner thirds. Following this subdivision we find that three of these growths were attached to the outer third, three to the inner third, and five to the middle third, and that the remaining two were not recorded, or else not made out. This does not bear out Mr. Wilde's statement, that in eight cases out of twelve these polypi sprout from the site of the ceruminous glands in the posterior wall of the meatus.

"It is possible, however, that Mr. Wilde may be correct, and a larger number of observations than the above would show such to be the case. I have seen polypi growing from the membrana tympani, and from the cavity of the tympanum, and have extracted them from both places.

"An examination of the intimate structure of these growths shows that they belong to two distinct groups. They were epithelial or fibrous in their character. Those which belong to the fibrous group presented the following characteristics: They were not invested by a distinct membrane, but were covered with a sort of tessellated epithelium. Internally, their color, when not reddened by infiltrated blood, was a pale pink, or almost of a grayish-white. Their general appearance was homogeneous. Under the microscope some of them exhibited fine parallel fibres. Others, a delicate fibrous structure, in which were numerous minute globules or granules; spindle-shaped or fusiform cells with free nuclei and smaller nucleoli abounded in all of them. Whatever else they contained the predominating elements were those of fibrous tissue in process of development, resembling what Lebert has figured under the head of fibro-plastic growth. Epithelial cells were often found in these specimens, but not in large numbers. The predominating elements were fibro-plastic. The individuals of this group were in reality small fibrous tumors. Their appropriate designation is that of fibrous polypi. They are evidently the same as those which Mr. Toynbee has described under the name of fibro-gelatinous polypi.

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* Clarke's.

"By reference to the table or the cases themselves, we learn that in every instance the meatus was either seriously diseased or bore evidence of previous serious disease, when the patient applied for relief. In a single instance, the meatus was free from redness and tenderness; but in this case the membrana tympani was so largely perforated as to be nearly destroyed, and thus exhibited conclusive evidence of antecedent grave disease. In all the other cases, the meatus was more or less swollen, red, and irritated. In a few instances the tenderness was excessive. We have met with two cases of extensive perforation following the removal of polypus by other surgeons. None of the perforations healed. There remained seven perforations, and in those in which it was not perforated it remained more or less opaque. After extraction the otorrhœa ceased in all but two cases, and in five out of seven of the other cases.

"The next point is the result of treatment upon these growths.

"So far as the polypi were concerned, it was most satisfactory in all of the previous cases.

"In all of them the polypus was so completely removed and eradicated that it did not return. It is true that in some of them years were necessary in order to attain this result;

yet it was fully attained. This accords with my general experience. I do not recollect a single case that fell under my observation in which a similar satisfactory result has not been reached, except when perseverance of the patient has failed, and treatment been renounced, before a radical cure could be effected.

"*The results on the hearing.*—The effect on the hearing was not so satisfactory as it was on the polypi, if we turn to the record. Large fibroid polypi which fill the whole meatus and protrude externally, the membrane being perforated, appear to grow from nearly the whole surface of the tympanic cavity, the entire mucous lining of which seems to partake of the hypertrophy. Growths of this nature are extremely apt to recur, even after apparent cure, but the degree of obstinacy with which they resist treatment is very variable.

"We find that in seven of the previous thirteen cases the hearing distance, as tested by the watch, was the same at the conclusion of treatment as at its commencement. The hearing was not improved by removing the growth. In the remaining six cases the hearing was improved.

"The local treatment consisted of extraction, cauterization, and occasional counter-irritation, besides the use of astringents, syringing, and sometimes of leeches.

"The constitutional treatment consisted chiefly of hygienic measures and tonics, especially iron. Iodide of potassium was used several times. The duration of treatment was recorded in twelve of the thirteen cases. In one of them, where no treatment except extraction of the polypus was requisite, the duration is put down as one day. The longest course of treatment was four years; the average duration was six months.

"By duration of treatment I mean not only the time occupied in the extraction or destruction of the polypus, but also that occupied in leading the tissues into such a condition that there was no danger of its reproduction. It appears from the preceding observations that this cannot be done at once. The extraction of the growth is generally an easy matter; it is not so easy a matter to prevent its return. In a number of these cases the patience, ingenuity, and persethe ear, and their frequent location is from the sides or bottom of a sinus, formed by ulceration in the wall of the meatus. "They may spring from the mucous membrane of the cavity of the tympanum, from the mastoid cells, or from the epidermal lamina of the membrana tympani. The formation of these polypi is attended with more or less pain and more or less discharge of blood, and often throwing off an offensive secretion."

"The indications for treatment are twofold: first, to remove or destroy the growth; and secondly, to restore the tissues to a healthy state as soon as possible. The first may be accomplished by retraction or cauterization, or by both of these measures combined, and sometimes by injection into the substance of the tumor. The second indication is answered by counter-irritation, the use of astringents, syringing, leeches, and such constitutional measures as may be required. Each of these points deserves a separate consideration.

"1. *Extraction.*—The ease and thoroughness with which a polypus can be removed from the ear depends as much upon the character of the growth as upon the instrument employed for its retraction. If the growth is soft, bleeding easily when touched, and adherent by a large base, it is not an easy matter to extract the whole at once. It will break up in the grasp of the instrument, and only come away in pieces; if it is not firm, or can be rendered so by the application of astringents to it, and is not attached by a broad base, it can easily and completely be removed by a single operation. As a general rule, fibrous are firmer than epithelial, and are consequently more easily retracted.*

With very few exceptions, Mr. Hinton believes, it is the best plan to remove polypi by astringents; and I have tried the effect of astringent powders, such as alum and tannin, upon their roots after removal, and have not found them, on the whole, by any means equally satisfactory.

One further remark seems called for on this subject, says Mr. Hinton in his supplement to Mr. Toynbee's work. At page 324 the latter lays it down generally as a rule that polypi should not be interfered with when disease of the brain is threatened, from irritation within or in the neighborhood of the tympanum. This is a rule which needs reconsideration, and, perhaps, even so accurate and thoughtful an observer has been in this particular unduly biased by the unfortunate issue of a single case. When cerebral irritation coexists with polypoid growths of any considerable size occupying the meatus, the removal of such growths should rather be a point engaging the earliest attention of the surgeon, for they are often themselves a chief source of irritation of the nervous centre by hindering the escape of matter. After their removal in such cases, indeed, it is no uncommon thing for the syringe to bring away large semi-solid masses of old discharge, the removal of which is followed by a great mitigation of the symptoms. In truth, the removal of polypi in these cases is only the carrying out of Mr. Toynbee's own principle of securing a free outlet for the discharge, a principle which should be applied without exception."

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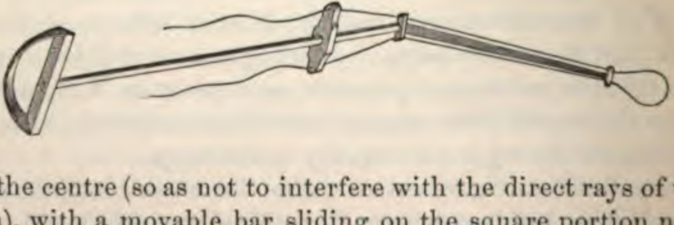
* Clarke, op. cit., p. 451.

The instruments for the operation of extraction are various, and must be chosen according to the indications of the case.

In certain cases the diminutive "ligature canula" of Leveret, with silver wire, string, or whipcord, will answer every indication.

The best instrument, and the one which I have always found adapted for the purpose, is Wilde's snare (Fig. 48). It consists of a fine steel stem five inches long, and bent in the centre (so as not to interfere with the direct rays of the sun), with a movable bar sliding on the square portion near the handle, which latter part fits over the thumb. The upper extremity is perforated with holes running parallel with the stem, and loops at the angle serve the same purpose. A fine

Fig. 48.



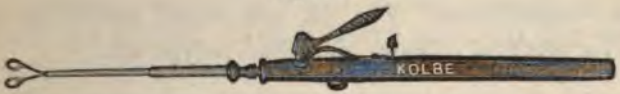
wire, fastened to the cross-bar, passes through these loops and holes. It should be of such a length that when the cross-bar is drawn tight to the handle of the ligature, it is fully on the stretch. The best form of wire is sheet-wire of No. 24 grist, with the temper taken out of it by heat.

Mr. Hinton remarks that Wilde's snare may be used of a larger size than that described by him, and is best armed, not with a wire, but with what is known to anglers as "jack-line," because it is more flexible, less brittle: it is easy to apply, gives no pain, and is not apt to fail.

There are several modifications of this instrument, most of them making it straight, but I think that many of them are useless, the original being the most convenient.

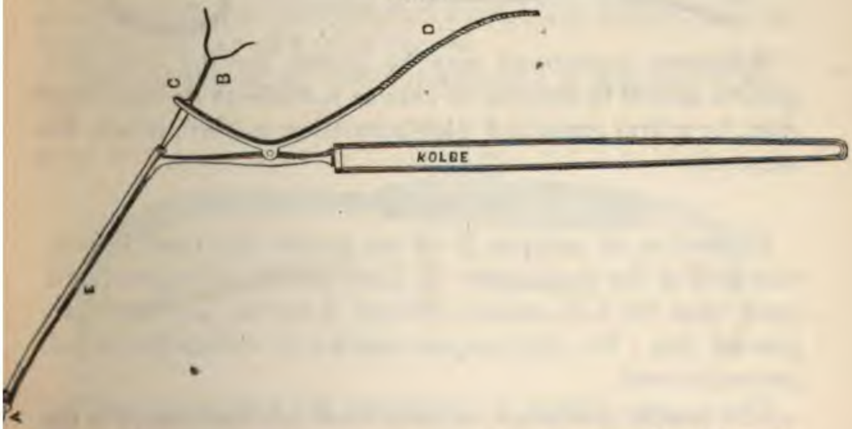
For very small vascular growths, the ring-and-lever forceps of Mr. Toynbee is an admirable instrument. (See Fig. 49.)

Fig. 49.



In some cases the ordinary ring forceps will be found to be suitable; and for others a form of instrument, Fig. 50, was found very useful in removing deep-seated polypi.*

Fig. 50.



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* Gazette Hebdomadaire de Médecine et de Chirurgie, Nov. 15, 1867.

At Figs. 51 and 52 are seen two forms of forceps for removing polypi and foreign bodies from the ear.

Fig. 51.

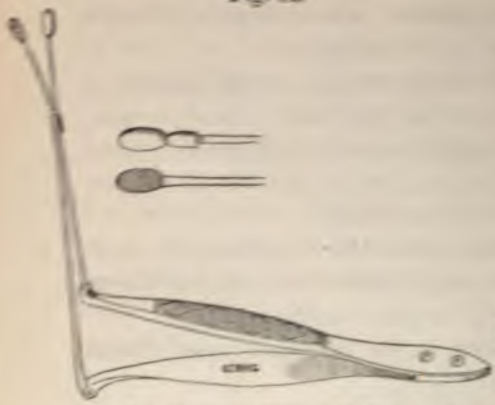
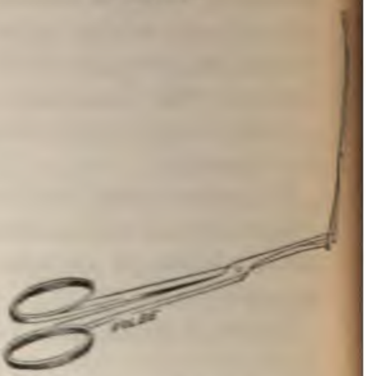
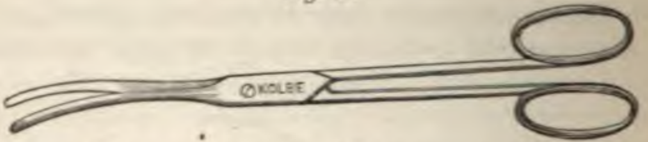


Fig. 52.



The "ear-scissors," Fig. 53, are found useful in many cases, for removal of hairs, detached polypi, etc.

Fig. 53.



Whatever instrument may be chosen for the case, the growth should be secured as near as possible to its base, and then, by a firm grasp and gentle twisting motion, it is to be removed.

CAUTERIZATION.

Extraction of polypus is by no means the most important part of the treatment. In most cases it will sprout and grow from its root, unless efficient measures are taken to prevent this. For this purpose caustics in various forms are generally used.

The caustic potassa is considered the best, as it can be used with the greatest safety.

The following plan of Dr. Clarke is recommended: Pack a layer of cotton, previously moistened with acetic acid, closely along the wall of the meatus, and, if possible, a little beyond the root of the polypus. Melt a piece of the potassa in a test-tube over a spirit- or gas-lamp. Dip the end of a probe—one whose end has been a little roughened is preferable—into the melted caustic. Do this once or twice, until the end of the probe is coated with it. As soon as enough has been collected on the end of the probe, pass it into the meatus and apply it to the growth.

A single application will sometimes be enough to destroy it completely.

The author has found equal parts of caustic soda and lime, moistened with absolute alcohol, a valuable remedy in vascular forms of growths; also tannic acid so moistened and applied.

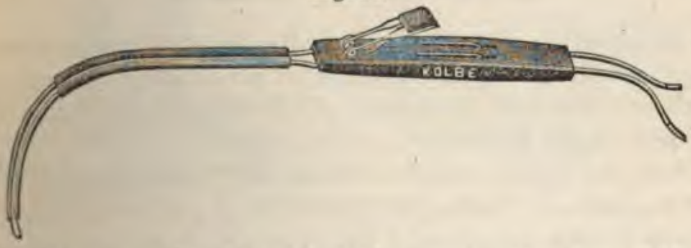
Nitrate of mercury is much more convenient, but by no means so efficient.

The galvano-cautery, produced by the passage of a galvanic current through a fine platinum wire, was first devised and employed by Middeldorf, of Breslau.

Dr. Mackenzie has made a modification which he recommends for removing large growths without hemorrhage and less pain than the knife. A battery of great intensity is required in connection, and it is necessary to be able to control the current so that the wire shall not be heated until in contact with the part to be burned.

The instrument we would recommend is depicted in Fig. 54, and was modeled for Dr. Cohen upon the plan of Mackenzie's laryngeal electrode.

Fig. 54.



Two copper wires, to be connected with the wires of the battery, pass through an ebony handle to the top of that handle, where they terminate beneath a metallic spring, which, when pressed down, forms a connection with two other copper wires passing out of the anterior portion of the handle, and which at their terminal extremity are connected by a short piece of thin platinum wire. The copper tubes are isolated by india-rubber jackets; and by twisting these wires the terminal extremity may be turned so that the cauterizing surface shall be present in any desired direction. The polyp to be burned having been reached, the loop of wire is made to encircle it; pressure upon the spring completes the circuit, and in less than two seconds the platinum wire is at a white heat. It requires a battery of great intensity. Dr. Cohen used six cells of the Maynooth battery which answered the purpose admirably.*

INJECTION INTO THE SUBSTANCE OF THE TUMOR.

A solution of the perchloride or persulphate of iron may sometimes be injected into the interior of the tumor with the happiest results, as stated by Dr. Clarke, who has treated one case with success. Two or three drops of either of the above-mentioned substances may be injected into the growth by means of a syringe, the hypodermic being the best to use. The result is sometimes the immediate destruction of the polypus.

ASTRINGENTS AND STYPTICS.

The condition of the growth, or the adjacent parts, sometimes renders a certain amount of preparation necessary. In these cases the appearance of the parts must guide us in our selection of measures to be adopted.

If they are not too much inflamed, astringents and styptics will be useful. Astringent solutions of various strengths adapted to the case, poured into the ear, while the patient leans the head down with the affected ear uppermost, will be found more serviceable than the same solutions applied by means of the syringe. Sulphate of zinc, tannin, alum, creasote, or carbolic acid, and a weak solution of iodine will be found to be some of the most serviceable remedies in these cases." The use of acetate of lead is recommended by Dr. Clarke. In some instances the substances named may be applied in powder to the part, especially in those cases where there is no perforation of the membrana tympani. When powders are used, they should be rendered, so far as practicable, impalpable.

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* Mackenzie on the Use of the Laryngoscope, with additions by Dr. J. Solis Cohen, p. 170.

They may be blown into the ear through a quill or through an appropriate instrument made for the purpose.

In the use of astringents it should always be borne in mind that only in cases of chronic inflammation strong solutions or their substitute in powder will be tolerated.

In cases of polypus with otorrhœa, cleanliness is of the greatest importance. Without careful measures to keep the parts thoroughly clean all treatment will be unavailing. Careful syringing with a good instrument will accomplish this object. Frequently the patient is disgusted with an imperfect instrument and a bungling hand working it. Dr. Thudichum's nasal douche (Fig. 55) will answer every purpose if fitted with an appropriate nozzle.

Fig. 55.

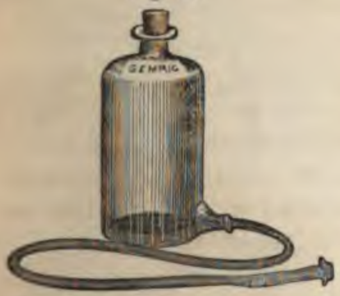
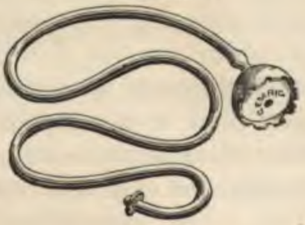


Fig. 56.



Another very convenient form of douche, applicable to the same purpose, is seen in Fig. 56, used with an ordinary pitcher on a shelf.

The discharge is best treated, according to Mr. Hinton, by absorbent powders, like "talc," removing the same by

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* Clarke, op. cit.

syringing, and sending a current of air by Politzer's method, so as to clear the Eustachian tube; more especially where there is perforation of the membrana tympani. In treating these cases, intercurrent inflammation, attendant upon the presence of the foreign substance in the meatus, must be checked by local and constitutional means. Leeches may sometimes be required, and if the object is to abstract much blood, they should be placed in front of the auricle. In young children it is safer to place them upon the mastoid process. Counter-irritation may be required where there is otalgia of a persistent character, attended with slight swelling and redness. In such cases a blister will be of great service. For this purpose the cantharidated collodion is best to be used, but croton oil and tincture of iodine may also be employed.

"Constitutional measures must be adapted to each case. Polypus is often associated with the strumous diathesis, and it is not easily eradicated, unless a change in the constitutional habit is produced. The weapons of defense of the physician against this protean form of disease are found among the tonics and alteratives and need not be described here."*

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* Hinton, op. cit.

CHAPTER IX.

DISEASES AND INJURIES OF THE AURICLE AND EXTERNAL MEATUS.

WOUNDS and injuries of the auricle are seldom seen except as the result of accident.

Ear-croppings and piercings for punishment have been supplanted by the more modern methods of boxing and pulling.

In Germany, however, the dueling with swords, one of the pleasures of "student-life," gives frequent injuries to the auricle, and these are usually incised wounds.

Wounds of the auricle may be either incised, punctured, lacerated, or contused, and treatment must be adapted to each case. The great object to be kept in view is always to prevent deformity if possible, and until this is observed it is never realized how much the ear contributes to the beauty and adornment of the head.

In cases of incised wounds, the parts should be brought accurately in apposition by means of an interrupted suture, the fine lead wire being preferable. In extensive injuries, where tissues are completely divided, sutures should be applied on both sides, care being taken to pass them through the integument only. Adhesive strips then complete the dressing. To protect the ear from the atmosphere, lint should be nicely placed around the part; this may be retained by a T-bandage, so modified as to suit the case.

In cases where a bandage is not at hand, the auriculo-occipital triangle of Mayor will serve as a useful dressing; a moderate-sized handkerchief being all that is required.

In cases where greater accuracy of adjustment is required, collodion will be found an admirable adjuvant in the dressings, especially if the prejudice against sutures in this part is entertained by the practitioner.

In wounds of the ear, if the parts be almost severed, and the attachment ever so small, we should not abandon the hope of recovering vitality and establishing union. Great attention should be given to the temperature, always endeavoring to keep it near the normal standard by artificial means.

In case the lobe has been destroyed or cut away, the loss may sometimes be supplied by a plastic operation.

The cartilage of the ear may be broken by crumpling up the auricle forcibly and suddenly; in these cases there is more or less inflammatory action, accompanied with pain and subsequent deformity. This curiously-formed organ is covered by a sensitive and delicate skin, and the hot flush and the burning blush are often seen to glow upon the ear, when at the same time a placid face and quiet brow bury all traces of emotion. It is said that even mental impressions affect the ear. Tradition has it, "That when the left ear is red, somebody is speaking well of you; when the right ear, the contrary." The auricle has a wonderful power for reparation after injuries, and one will often be surprised to see how little deformity follows serious injuries of the ear. The operation of piercing the lobes, which is fashionable in common with the savage and enlightened, for reasons alike satisfactory to both, is sometimes followed by grave consequences.

The operation is generally performed by thrusting an awl or needle of proper size through the lobe, which is pressed against a piece of cork held firmly against its back.

Sometimes inflammation of a grave character attacks the auricle in consequence of severe and protracted disease, which causes the patient to repose constantly on one side, and by the continued pressure of even the softest pillow the ear becomes ulcerated, and this sometimes ends in sloughing of the part. This takes place more readily because of the languid state of the circulation and the inability of the capillaries to resist injury, and in phthisis this injury frequently results from the patient being compelled to lie constantly on one side. Other causes of inflammation are the stings of insects, etc. These forms of inflammation are easily managed, and are to be treated on general principles. One of the most troublesome forms is that induced by cold. In this climate the chilblain of the ear is by no means uncommon; and trifling as it may seem to have the "ears frozen," the subsequent irritation, and even decided injury that may follow, are not unworthy of consideration. Such cases should be treated by restoring the normal circulation by the application of snow or cold water, and the inflammation that follows, by gentle stimulation; one of the best applications is as follows:*

℞.—Nitric Acid, 1 minim;
Tinct. Opium, 1 drachm;
Water, 1 ounce. M.
Sig. Apply externally, once daily.

Phlegmonous inflammation not unfrequently invades the auricle. This runs the usual course, often terminating in abscess, and must be treated on the general principles of surgery. Furuncle of the auricle is sometimes seen, and this must also be treated on general principles.

Gouty inflammation of the auricle, Wilde declares, has been fully established. The same author gives Graves the credit of having pointed out this form of congestion and redness of the auricle in patients of a gouty diathesis. Garrod has called attention to the frequent occurrence of uric acid depositions in the auricle in cases of individuals with an arthritic diathesis. These arthritic deposits were the most frequent of all the external symptoms, and they are therefore of some importance in the diagnosis of gout. Among seventeen patients with gout in whom the deposits of urate of soda were found, Garrod found them on the ear nine times, and at the same time in the vicinity of the joints,—seven times on the auricle alone; and of all the cases where they existed in the joints there was only one in which they could not also be found in one of the ears.

They are most frequently seen on the upper portion of the helix.

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* Sissay on Diseases of the Ear, translated by N. R. Smith, M.D. Baltimore, 1829.

They have not been observed as yet on the lower third of the auricle. Their size varies from that of the head of a pin to that of a pea.

TUMORS, ABSCESSES, HÆMATOMA, AND SCIRRHUS OF THE AURICLE.

We have in the auricle tumors of various kinds,—encysted, steatomatous, sebaceous, fibrous, and bloody. The encysted, steatomatous, and sebaceous are generally small, and not frequent, while the fibrous of the lobules of the ear are more common and are sometimes of considerable size. A case of hypertrophy of the lobe is related by Boyer, in which it reached to the neck of the patient. Wilde* was the first to accurately describe and figure one of these morbid growths, and determined that it was of a "yellowish-white fibrous appearance." Mr. Paget† also refers to them as one set of fibrous tumors. "These," he observes, "are trivial things in comparison with the tumors of the jaws, yet they have points of interest, in that they grow after injuries and are very apt to recur after removal. He also reports cases from Mr. Holberton, presented to the museum of St. Bartholomew's Hospital, in which both lobules were cut off with the tumors, but in or beneath one of the cicatrices a similar tumor formed shortly afterward. This was excised; and in the ten years that have since elapsed there has been no return of the disease. In another case, related by Mr. B. Barrow, two such tumors formed in the same ear after puncture. One of these was cut away, the other was left; a third grew, and the excision of the whole lobule was necessary for the complete extirpation of the disease." Prof. Alfred Stillé‡ reports an interesting case in a young lady; and describes the tumor when cut "to be smooth and shining, of a pale-pinkish color, and fibrous bands were visible, diverging from its point of attachment to the circumference. The mass of the tumor was formed by an opaque, elastic substance of an albuminous appearance." Similar instances of tumors of the lobe are recorded by Bruch, Venzetta, Hinton, Gross, Norris, and others. The following is one of a number of cases which occurred in the author's practice: About one year ago (1869) a young mulatto girl, aged eighteen years, bored her ears with an ordinary needle and inserted in them a silk thread. After the ear ceased to swell and the inflammation had passed away, she removed the silk and placed in each ear rings of impure gold. Soon after, the posterior surface of each orifice began to swell and gave her pain. The rings were removed, and not worn again. The swelling gradually increased, but more in the left than in the right ear, and within a few months have grown so rapidly as to become a deformity which she wished removed. The tumors were round, and measured on the left about three-quarters of an inch, on the right half an inch, through their long diameters. On the anterior surface, where the orifice had been, there was a small elevation. Both tumors were covered with the natural skin, and were firm, yet elastic, to the touch, and without pain. The largest of these tumors was removed by carefully dissecting back a portion of the skin covering it, and then cutting into the lobe in the form of a double-convex lens, and the skin was then brought over the wound. A single stitch sufficed. A small space was left to granulate. Subsequently the granulations were touched with nitrate of silver and dressed by a simple ointment and bandage, with isinglass plaster. The parts healed, and the operation produced no deformity. April (1871) the case reported above returned to have the tumor in the opposite ear removed; the one operated on did not return. On microscopical examination the tumor was found to be fibrous, with some fat cells.

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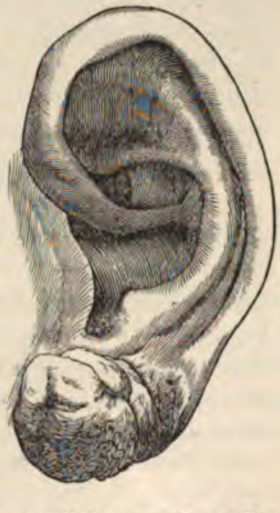
* Practical Observations on Aural Surgery. June 12, 1853, Dublin; Am. ed., Philadelphia, 1853.

† Lectures on Surgical Pathology, 1847–1852, London; Am. ed., Philadelphia, 1860.

‡ Proceedings of the Pathological Society of Philadelphia, January, 1861.

Fig. 57.



The figure (57) will show the form of the tumor; although it was of a much larger size, involving the entire lobe. It also shows two rings upon it, as if compressed by a string. This specimen is the largest of a pair, one in each ear of a mulatto girl. Mr. Paget states that "these tumors are penalties attached to the barbarism of ear-rings;" and yet how many thousand wear ear-rings without ever suffering in the smallest degree from such tumors! I am of the opinion that they are owing to some peculiar condition of the system (scrofulous) chiefly, or some galvanic action in the mixed metals employed in the manufacture of the jewelry which is sold for pure gold. I am supported in this opinion by the numbers of such that occurred, not in the true negro but in the mixed blood of the white and black, which are more liable to scrofulous diseases than the true negro. "If," observes Mr. Wilde, "tumors of this description were frequently to follow the irritation of piercing the ears, we should find them much more common, particularly among those nations who wear very large, heavy pendulous ornaments, which is not the case. Dr. Graves has published a case of fatty deposit in the lobes; the patient died subsequently, and Dr. O'Ferrall found upon dissection a fatty degeneration of the liver and fatty deposits in other portions of the body."* We have also had cases in the pure "white" skin, where the ear-rings were so large as to have torn the lobe in two; also cases where little children had lacerated them; yet they united without deformity, and no tumors followed.

HÆMATOMA AURIS.

For many years it has been observed in asylums that the insane are prone to suffer from swellings and indurations of the ear. By some these swellings have been attributed to mechanical injuries, whilst others have urged that this explanation is not applicable in many cases, for the frequent symmetry of the diseased condition makes it important in most cases to determine some other cause.

M. Ferrus, in France, and Bird, in Germany, first called attention to these sanguineous tumors in 1838. Dr. E. R. Hun, of the New York State Lunatic Asylum, reports (Am. Jour. Insanity, 1871) twenty-four cases of this affection occurring twenty-three times in man and only once in woman.*

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* Wilde, op. cit., p. 168.

"Dr. Laycock, from a wider investigation of the symptomatology of the ear, arrives at the following (among other) conclusions: 'That the states of the circulation, nutrition, and development of the tissues which make up the ear-lobule, and cover the helix, very commonly coincide with similar conditions of the encephalic tissues.'† If this be substantiated, if there be indeed a correlation between the nutrition of the brain and that of the ear, we have an explanation of the occurrence of hæmatoma in insanity. Be this as it may, however, the following example of the symmetrical formation of hæmatoma in a person who had certainly received no injury, is of much interest in reference to her history.

"Mrs. G.,‡ aged twenty-six, the wife of a sailor, married four years, but never had any family. She came to me on March 7th, with a large swelling on the upper part of the right ear. The swelling was at least the size of a walnut, tense, and fluctuating. It has been opened several times during the three or four months which it has been forming, and nothing but blood had ever been obtained. The surgeon on one occasion had put a seton through it. There had been great soreness in it, and the skin and cellular tissue near to the ear were considerably swollen from extension of the irritation. I opened the swelling freely, fully expecting to obtain pus, but none came, only a thin, bloody fluid.

"I kept the opening free from day to day, and the inflammation slowly subsided.

"On March 25th she mentioned that she feared her other ear was about to be affected in a similar way. I found a thickening of the cartilage, with decided fluctuation. There was no redness, but it was very tender on pressure. The fluctuating part was ill defined; the skin appeared thinner on the inner side of the cartilage. Exactly the same part was affected as in the other ear. I had suspected from the first that the case was similar to the hæmatomata of the ear met with in mania, and this symmetrical occurrence tended to support the idea. On inquiry I learned that a paternal uncle had been insane. Mrs. G. herself was of heavy aspect, with a small forehead and large face. Her ears were large in the upper part and wanting as to the development of the normal curves. Her husband was at sea. She told me that she had of late been very sleepless at nights and somewhat depressed in spirits, with a feeling that something was hanging over her; felt often cold. She had lately lost flesh and become paler, but was still in good general health. Catamenia irregular during last three months. Appetite rather poor."

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* The Medical Record, New York, January 2, 1871, p. 490.

† Medical Times and Gazette, March, 1862, p. 289.

‡ Case of hæmatoma auris, under the care of Mr. Hutchinson, Medical Times and Gazette, December, 1862, p. 603.

The above case is not very conclusive, and having seen but very few cases of this disease I wrote to some of the highest authorities, chiefs of our insane institutions, and the following is an abstract of their replies.

Dr. Thomas Kirkbride, the distinguished physician-in-chief of the Pennsylvania Hospital for the Insane at Philadelphia, in a private letter to me on this subject, says: "The swelling has seemed to me the result of an injury to the part, and the best treatment that I have tried is the application of ice to the tumor at the very commencement. This seems to prevent the enlargement which otherwise is pretty sure to occur. I have seen great deformity caused by it. I have never satisfied myself that it occurs without any contusion."

Dr. John Curwin, physician-in-chief of the Pennsylvania State Lunatic Hospital at Harrisburg, thus writes:

"We have no cases of 'hæmatoma auris' at this time in the hospital, and have not had for some time past. My own impression about these affections is that they are the result of a blow or fall upon the ear, and are only developed when the nutrition generally is below par. If Dr. Laycock's theory be true, they would be more frequent than they are. I have not seen a large number of them,—say twenty in eighteen years, not including those I saw at the Pennsylvania Hospital for the Insane at Philadelphia as assistant physician,—and as a rule they are almost invariably confined to males; some say altogether, but I have seen one or two cases in females. I have tried all kinds of means for their removal, but have never found anything equal to the application of tincture of iodine once or twice a day, as the case may demand. This reduces the tumor with less disfiguring than any other means; but the ear rarely resumes the same condition and appearance it had before, a slight degree of thickening always remaining."

No apology, I trust, is necessary in giving the letter of the chief physician of the "Friends' Asylum for the Insane at Frankford, Pennsylvania," as he enters very fully into the subject, and he has had a large number of cases under charge:

"Respected Friend,—Thy note of yesterday is at hand. In reply, I may say that I have had a pretty large number of the cases inquired after under observation, and will with pleasure give thee briefly the result of my experience.

"I have never seen a case of the affection in a sane person, nor in a case of curable insanity. I always consider the affection of the *ear* an evidence of an incurable form of insanity, such as I have described in the Journal of Insanity as 'congestive mania.' I believe it is always associated with a tendency to congestion of the membranes of the brain or the cerebral substance itself; and I should think, in a general way, that Dr. Laycock's opinion was correct. The affection seems to be in the perichondrium, which secretes a bloody serum, with which the cellular tissue becomes infiltrated. The best treatment would probably be a lotion of liquor plumbi et tinctura opii, but owing to the difficulty in making any application to the class of cases affected, which are generally unmanageable, I have tried the method which has uniformly proved satisfactory, the swelling disappearing in a few weeks and leaving only a slight pucker under the skin, such as you might suppose a cicatrix in the perichondrium would present. The practice of opening the tumor is altogether unnecessary, and therefore I think un-

[illegible] and appearance of the lesion would [illegible] injury; but as these tumors are never [illegible] of the insane equally turbulent, or in [illegible] especially liable to blows from falling in [illegible] something specific in the cause and [illegible] affection; and in the cases I have observed [illegible] be the result of an injury by a blow or [illegible]

"Thine very truly,
"J. H. Worthington.
[illegible] M.D."

[illegible] Kramer, of Berlin, treats of "inflammation [illegible]" as presenting essentially different [illegible] to the general state of the patient's [illegible] constitutions a bright-red swelling; in [illegible], on the other hand, it is bluish-red. [illegible] bloody tumors are unknown, though he [illegible] are especially likely to be produced by [illegible] ear), which perhaps explains their [illegible] on the left ear. If the inflammation [illegible] in a strong constitution, with synocha, [illegible] rest, cooling diet, mild aperients, and [illegible] repressive applications of lead lotion. [illegible] surgical interference with the tumor must [illegible] its size and presence or absence of fluctu- [illegible]

[illegible] indurated degeneration of the auricle [illegible] of a return to a healthy state. The [illegible] inflammation is extraordinarily protracted, [illegible] years, or even through the whole life [illegible] it may almost always be considered [illegible] a more or less strongly-marked scrofu- [illegible] The treatment must be essentially con- [illegible] directed to the general condition of the [illegible] farinaceous food, and, in general, all

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[illegible] the Present Day, by Dr. William Kramer. Lon- [illegible] food difficult of digestion, should be excluded from the diet of these cachectic patients. They require strong, nourishing aliment, both fluid and solid. It is indispensable that the bowels should be kept freely open, but in cachectic individuals this should not be allowed to pass into diarrhœa. Either artificially made baths, or those especially of Kreuznach, Nauheim, and similar places should be taken; and at the same time the Adelaide and Eliza Springs, whey, iodide of potassium, etc. If these means should fail, we may employ, if the patient's strength will permit, Fowler's solution of arsenic, in doses of from two to four drops two or three times a day, a quarter of an hour after meals. The local treatment consists in carefully removing and drying up the diseased secretion by means of a soft sponge dipped in warm water, and subsequently powdering the surface with the semen lycopodii. If the itching and burning be very severe, soft lint dipped in a warm solution of zinc (gr. ii–iv, ad. ℥j water) should be placed upon the ear. Thick, hard, purulent scabs are softened, with great relief to the patient, by the application of warm bread or linseed meal poultices. Where all these means fail, relief to the patient can be obtained by the partial or entire removal of the auricle."*

CANCER OF THE AURICLE.

True cancer of the auricle must be a very rare disease, for in my hospital and private practice I do not remember seeing more than a single case. This is also the experience of Wilde. Yet I have met with many cases of abscesses and irritable ulcers on the auricle. This diseased condition is to be treated by alteratives and tonics, with the local application of solutions of zinci sulphas, acid. carbolici, or permanganate of potassa. When the elevated edges or nodules require removal, we resort to the sulphate of zinc paste, chloride of zinc, or the compound powder of caustic soda and lime, mixed into a paste with absolute alcohol. In some cases the solution of the protonitrate of mercury may be used.

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* Kramer, op. cit., p. 39.

DISEASES OF THE MASTOID AND PRE-AURICULAR REGION.

Wilde,* "without entering too minutely into the subject of tumors behind the ear," specifies six varieties. "The first is a small gland lying upon the mastoid process, immediately above the insertion of the sterno-cleido-mastoid muscle, and on a level with the auditory canal of the ear, which sometimes enlarges to the size of an almond. It becomes highly irritable and painful to the touch, so as occasionally to resemble a neuroma. It generally occurs in young females." We have seen a number of these tumors, and have found the application of a solution of camphor in an equal weight of chloroform highly beneficial in relieving pain; we also used the solution of iodine in aqua ammonia locally at night. Internally we administered the iodide of iron. If the tumor be large, or if there are several, we have applied, with the happiest effects, the mercurial plaster, with as much camphor as can be incorporated with it and yet not prevent it from adhering. The three varieties next described are not true tumors, but suppurating glands or chronic abscesses, with or without periostitis of the mastoid process. The fifth is a true aneurism of the posterior auricular artery. The sixth tumor described by Wilde as occurring in this region is a malignant fungus, of which he has seen three cases—one in a boy aged ten, the others in adults who had passed the age of fifty. We have only had two such cases to treat. One was in a delicate child, and involved the whole of the mastoid process and side of the neck. The case was brought to the Howard Hospital, but very little could be done for it. The second was a woman aged fifty-six. Her statement was that it began as a tumor behind the ear, and that she had consulted a surgeon, who pronounced it an abscess and cut it open. It discharged some blood, and soon after the operation it began to enlarge, the edges of the ulcer becoming everted. When we examined it the mass of fungus had penetrated into the meatus through the auricle, and was disposed to bleed on the slightest touch, and there was an ichorous fluid discharging constantly. She was placed upon the use of the following mixture:

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* The Nature and Treatment of Diseases of the Ear, p. 175.

℞.—Tr. Cinchonæ Comp. f℥j;
Liq. Potassæ Arsenit. fʒij;
Syr. Simplex,
Aquæ, āā f℥ij. M.
Sig. A teaspoonful after each meal.

She also used alternately solutions of sulphate of zinc and carbolic acid and the solution of persulphate of iron as a wash, so as to remove the disagreeable odor and prevent hemorrhage. She continued to attend as an out-door patient for several months, without much increase in the size of the growth.

In the true epithelioma excision or amputation is the treatment in the early stage.

MALIGNANT DISEASE OF THE AURICLE.

The following case of malignant disease of the auricle is reported by Dr. Green* (with remarks), and is worthy of record on account of the success which followed the operation by Dr. Thaxter.

"J. M., aged sixty, night-watchman, entered Dr. Thaxter's wards at the Boston City Hospital on April 21st, 1870. He stated that some eight months before, without having ever had any previous trouble in the ears, an eruption appeared on the right auricle, from his description apparently a moist eczema. From that the present condition has gradually developed itself without pain or symptoms of any kind whatever. No treatment had been adopted from the beginning.

"The lower half of the right auricle was found to be very much enlarged in all directions; the concha and upper part of the lobule were covered by a superficial ulceration, from which an offensive sero-purulent fluid exuded, forming a dark crust. The lobule was occupied by several nodules about the size of hazelnuts, of a purple color and very hard; between these were several bleeding fissures. The neighboring ganglia were not affected.

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* Transactions of American Otological Society, p. 62.

"On examination with the speculum and Tröltsch's mirror, I found that the ulceration did not extend into the meatus, but that the whole inferior wall of the passage was swollen and indurated as far as the edge of the osseous meatus. The deeper parts of the passage were filled by a large mass of loose hairs, which were removed, and the membrana tympani was then seen to be opaque, somewhat swollen and congested along the manubrium. The hearing was considerably diminished on that side, the watch being heard only at the distance of two inches, and there were constant subjective noises.

"The appearance of the disease leaving no doubt as to its character, excision was performed by Dr. Thaxter under ether, the whole auricle being amputated close to the skull. The whole lower half of the cartilaginous meatus was then dissected out down to the edge of the osseous meatus, and found to be indurated. The remaining tissues appeared to be healthy. The bleeding was profuse, but easily checked by tying a few small vessels. Cold-water dressing was applied, and the wound left to granulate.

"The wound healed rapidly, and at the end of a fortnight was not more than one inch in circumference. The process of healing then became slower, and the granulations at the meatus threatening to close that passage, a pledget of lint was kept in it all the time. The granulations were occasionally touched with solid nitrate of silver, and stimulating lotions applied. At the end of four weeks the whole wound was cicatrized, except just at the edge of the meatus, the opening of which was now only about one-eighth of an inch in diameter. The hearing had improved, and the subjective noises were gone; the swelling and congestion of the membrana tympani had disappeared, leaving that membrane dull and somewhat thickened, but otherwise normal.

"The patient now demanded his discharge, promising to return as an out-patient, but no more was seen of him for four months, when, on meeting him, I learned that after leaving the hospital he neglected all dressings, and the ear soon healed. The meatus I found to be closed by a firm layer of cicatricial tissue, and the hearing power was less than when last examined. There were no signs of any return of the disease, and he expressed himself as perfectly satisfied with the result of the operation.

"In looking up the literature of the subject I have been able to find but little. Neither the text-books on the ear nor on disease of the skin mention the auricle as a likely seat of epithelial disease. In the *Gazette des Hôpitaux*, September 30th, 1869, M. Demarquay describes a case in a robust man, seventy years old, who entered the *Maison Municipale de Santé*. He had lost one leg from disease of ankle, and had had caries of one phalanx; also a hemiplegia on the right side, from which he had nearly recovered. At first a small wart appeared on the middle of the left helix, was scratched off, but immediately returned; it was then cauterized with nitric acid, but gradually extended, and in seven months had formed a brown crust, with a hard, indurated base. Below this crust was an ulcerated, slightly-painful, bleeding surface, which extended in spite of caustics.

"On entrance, the tumor occupied the upper part of the auricle, was 6 cm. long by 1½ cm. wide, more dependent in the middle than at its extremities; the base was indurated and adherent to the cartilage, its borders hard, defined and red; the surface irregular, and ulcerated. On close questioning, he admitted shooting pains in the meatus, but none in the affected part. The characteristics of the tumor left no doubt of its nature, and it was proposed to excise all the affected parts with the scissors, but the patient refused to submit, and left the hospital.

"M. Demarquay remarks that in such cases all authors are far from partial to the knife. M. Sédillot considers the actual cautery sure of success, and in a patient of his, fifty-five years old, in whom the whole auricle had been destroyed by cancroid in less than three months, and the disease had invaded the auditory canal, the actual cautery applied to the ulceration and repeated many times produced a firm and persistent cicatrix, which he claims could have been obtained in no other way. Velpeau, on the contrary, resorted to excision in the case of a patient, sixty-seven years old, where the growth had existed only two months. The tumor (size of a filbert) was firm, fleshy, ulcerated on the surface, and movable with the skin on the deeper parts; occasionally there were lancinating pains in it. When small it had been removed, but had recurred. As the neighboring ganglia were not affected, excision was considered practicable.

"Malignant tumors of the auricle offer the peculiarity of rapid development which often renders the ablation of the part indispensable; in this they differ from cancroid of the lip, which develops slowly. Velpeau had already pointed out this fact, and in the case reported by him (*Gazette des Hôpitaux*, 1864), it enabled him to decide on the malignancy of the tumor, and he diagnosticated a cancerous tumor containing probably fibro-plastic tissue and the elements of encephaloid cancer. Dr. Campbell states that many of the inhabitants of Nissal have tumors of the auricle, especially those afflicted with goitre. Two of them which he removed occupied the whole auricle, invaded the meatus, and affected the hearing, and their tissue resembled mammary sarcoma.

"Brunner narrates in the *Archiv für Ohrenheilkunde*, vol. v., a case of epithelioma of the ear which he considers began primarily in that organ. For two years the patient, a healthy woman, aged fifty-two, suffered from severe itching in the right ear, and was in the habit of frequently scratching it with a hair-pin. A slight otorrhœa then began, without pain or other symptom. A few weeks after an exposure to cold she had severe pain in the ear, which soon diminished, but continued in slight degree. Two months after this the right facial nerve suddenly became paralyzed. Examination at this time showed the right meatus to be completely filled by a soft, reddish, spongy mass, exactly resembling granulations; the otorrhœa was slight, and more mucous than purulent; the auricle and surrounding tissues of ear normal. A microscopic examination of a small piece of the growth, by Professors Eberth and Billroth, showed an undoubted epithelial carcinoma. As the growth involved the labyrinth wall, no operation was attempted, and the treatment was symptomatic only. The pain increased, ulceration took place, and the auricle was partially separated. One year after the beginning of the otorrhœa she died. No autopsy was made.

"The case which is reported is interesting, from the disease having extended from the auricle into the cartilaginous meatus and yet having left the deeper parts intact, and from the result of the amputation, which shows that in such cases the complete closure of the meatus must be specially guarded against."

Gruber* describes and figures a most formidable disease of the auricle under the term "Angioma," the edge of the helix being filled with a mass resembling hard cancer, and in the centre is a bloody tumor with an opening resembling an othœtomata. The treatment consisted of the emplastrum diachylon, ʒij, with antimonii et potass. tart. grs. xviij, or the subcutaneous injection of the dilute liq. ferri sesquichlorate; also acupuncture. Where these remedies fail, he recommends the removal of part or the whole of the auricle.

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* Lehrbuch der Ohrenheilkunde, p. 409. Wien, 1870.

CHAPTER X.

PRURITUS—ACUTE AND CHRONIC ECZEMA—FURUNCULOUS ABSCESS—OSSEOUS TUMORS—OTITIS EXTERNA.

PRURITUS of external auditory canal is frequently observed. Dr. Gruber,* in inviting attention to this affection, says it is either overlooked or treated of too summarily in treatises on diseases of the ear. Itching of the auditory canal is often met with during the progress, or at the termination, of inflammatory action. The affection indicated resembles in all respects the pruritus cutaneous of Hebra. Intense itching of the meatus constitutes the only objective symptom, the lining membrane of the passage exhibiting no trace whatever of any changed appearance. Gruber notices that in aged persons, suffering from this affection, the passage is often found very dry, and without a vestige of cerumen. That this is no essential feature of the disease is seen in other cases in which the secretion is found in excess. This "pruritus" is often met with in persons of middle age, and especially in those in whom there exists some disturbance of the circulation. Thus, those suffering from hemorrhoids or large varicose veins seem to be liable to it, and even children are not exempt. The itching often comes on periodically, that is, in the evening, the patient having been completely free during the day. Often it is absent for months, and returns again with distressing severity. In Gruber's cases the affection appears to have been strictly local, no other part of the body participating in the irritation. Sometimes, as the result of the constant scratching induced by this affection, an artificial eczema, or diffuse inflammation, is set up.

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* British and Foreign Medico-Chirurg. Review, April, 1869; from Allg. Wien. Med. Zeit., Dec. 1868.

The causes of pruritus of the ear are not well known. It is sometimes accompanied by an eruption of papulæ of nearly the same color as the adjoining cuticle. Wilde quotes from the *British and Foreign Medico-Chirurgical Review*, vol. xvii. p. 414. Pruritus of the external meatus auditorius, from hyperæsthesia of the auricular branch of the pneumogastric, is sometimes observed, and is accompanied by cough and vomiting. Sensibility of the terminal portions of the cutaneous nerves may induce distressing itching, which will torment the patient for hours without change of structure being induced by stimulants, changes of temperature, indigestion, etc. Mental excitement or depression seems to have a decided influence upon the disease. Sometimes the affection disappears suddenly, and subsequently returns as unexpectedly with unabated violence; this should always be remembered in our prognosis.

Diagnosis.—The character of the itching, which is tormenting, annoying, and periodical, without evidences of inflammation, or other change of structure of the skin, will usually guide to a correct diagnosis. The attacks come on suddenly, and continue for hours, and then as suddenly abate. The violence done during the attack, from the irresistible desire to scratch, increases the irritation.

Treatment.—As a palliative treatment, a few drops of glycerine may be used. Mere chronic and habitual sufferers should be taught to pencil the auditory passage with the substance just mentioned, or ointments, such as the citrine or oxide of zinc. And those whose night's rest is liable to be disturbed, should introduce lint imbued with such substances, and leave it in during the night. The ceratum plumbi subacetatis, with equal parts of ungt. aquæ rosarum, will be found of great service in many cases. A more radical means of cure is penciling the meatus with a strong solution of nitrate of silver, gr. x to f℥ij of water. This should be done in a good light, so as to avoid the membrana tympani, and must not be continued after signs of reaction. This must be again repeated should the itching reappear. In all cases great attention must be given to the general health, and condition of the digestive system. Acid products from indigestion seem to produce this affection in those liable to attacks. The same tendency is seen in females dependent upon disturbance of the menstrual function. In these cases special attention must be given to the disturbed organs.

Arsenic, in the form of Fowler's solution, will be found invaluable in cases that have defied all other treatment. Local applications of solution of carbolic acid, acetic acid, bichloride of mercury, or sulpho-carbolate of soda may be used with advantage, ever bearing in mind that judicious consideration of the character and temperament of the patient must be exercised in selection of the remedy. These lessons are learned only by experience, guided by principle, and, although theoretically empirical, form the basis of judicious practice.

ACUTE AND CHRONIC ECZEMA.

The acute form of this eruption commences with some disturbance of the general system, and shows itself locally upon the auricle by the discharge of a serous fluid. When the vesicles are rubbed, they peel off, leaving a slightly red surface. The eruption gradually extends over the face; there is itching and heat of skin, and when cloths are applied they become stiff with the secretion, which dries very rapidly. A clinical case may assist the knowledge of this affection.

Mrs. Eliza ——, aged thirty-five, applied at the hospital, April, 1870, with acute eczema. She was nursing her infant, and had been attacked four or five weeks before applying for treatment. The eruption commenced behind her ear, then extended over ear and side of face, upper lip, and forehead. Even over her neck, there were numerous clusters of whole and broken vesicles, containing a serous, and some a purulent, matter. There were also scales, which, on removal, left a deep-red surface. There was itching and smarting of the surface, the auricle and meatus red, swollen, and tender. The parts were ordered to be kept moist with mucilage of slippery elm and flaxseed, in each pint of which was dissolved biborate of soda ℨi. A mild anodyne was given to induce sleep, to be followed by a saline laxative in the morning. Believing the eruption to be dependent upon debility, she was advised not to nurse her baby, and was given an infusion of Peruvian bark. This treatment she continued for two weeks with but little benefit, when it was changed for the application of the benzoated oxide of zinc ointment, and five drops of Fowler's solution in the bitter infusion. A month's treatment caused the disappearance of the eruption and a return to her ordinary condition of health.

CHRONIC ECZEMA AURIUM.

This is especially a disease of females in middle life, affecting the ear, as a sequela to the cessation of the menstrual flux, and taking the place of the headaches so common during this period. It becomes very annoying from the itching and watery discharge, soiling the collar and neck with scales, and also filling up the auditory canal, often causing great pain.

Diagnosis.—In the acute or simple variety we find clusters of minute vesicles without much redness, and in the chronic form we have chaps and fissures pouring out an abundance of ichorous fluid, and at a later period copious desquamations. According to Wilson (and this we can confirm from our own experience), small subcutaneous abscesses form in the integument around the ears, and the neighboring lymphatic glands frequently enlarge; and in one instance under the author's care there occurred sympathetic irritation of the brain.

Prognosis.—If the case be seen early, and the constitution is good and strong, the prognosis is favorable; but if the case is of several years' duration, the results are not always as satisfactory as we could desire; still, much can be done to improve and modify, so as to make the patient's condition more comfortable.

Treatment.—In the case before referred to, of several years' duration, in which, during the treatment, the brain was very much disturbed, after trying a great variety of remedies, the patient finally was relieved by the use of the following solution, and oin ent of the acetate of lead and mercurials, continued with care for several months:

℞.—Bichloride of Mercury, gr. j.;
Arsenious Acid, gr. j.;
Hydrochloric Acid, ʒj.;
Water, ℥viii.

Boil the Arsenious Acid and Hydrochloric Acid in water, and add the Bichloride of Mercury.*

The dose, from 5 to 10 drops, in water, 3 times a day.

The following case from Wilde is so characteristic of many we see at our public hospitals and clinics, and being related in his inimitable style, we cannot do better than give it at this time:

"M. Q., a female, aged sixty, has been deaf, 'off and on,' for several years past, accompanied by noise and wandering pains in her head, with extreme itchiness in the auditory passages. The skin covering the auricle, and the scalp adjacent thereto, is of a fiery red color, speckled with patches of yellow, formed by the exudation which has collected in thin, branny scales all over it. The parts are hot, and in some places sticky, from a thin ichorous matter which exudes from the surface. The auricle has lost its natural shape, its folds and sinuosities being partially obliterated, and it has become hard, thickened, and lumpy. The external auditory aperture, owing to the disease extending into it, has been reduced to a third of its natural size, and is filled with branny scales. Upon removing the latter impediment, we can obtain but a very partial view of the membrana tympani, which appears to be thickened and opaque. Hearing distance, [illegible]. The state of the parts is nearly the same on both sides.

[illegible] of this description, and like this, of long standing, are very hard to manage, because there generally coexists [illegible] constitutional taint;—so that while we employ local remedies, we must not neglect constitutional means, and [illegible] diet should be enforced."†

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* [illegible] Hospital for Skin Diseases. Med. Times and Ga- [illegible] 28.

† [illegible] p. 177.

The ointment before referred to was as follows:

℞.—Acetate of Lead, ʒss;
Oxide of Zinc, ʒi;
Mild Chloride of Mercury, ʒss;
Nitrate of Mercury Ointment, ʒi;
Lard (washed), ℥ss;
Pure Palm Oil, ℥ss. Mix.

With many cases this severe treatment is not absolutely necessary, and the mild mucilaginous applications—the ear being covered by oil-silk—have been attended with success. In another class of cases we resorted, with good results, to the ointment of nitrate of mercury, of double the ordinary strength, which was kindly prepared by Mr. Bullock, of the firm of Bullock & Crenshaw, of this city.

Hebra, quoted by Gruber, recommends the following ointment:

℞.—Ol. Oliv. Optim. unc. 15;
Lithargyri unc. 3 et dr. 6;
Coq. l. a in ung. moll.; dein adde
Ol. Lavand. drachm 2. M.
Ft. Ung.

The following powder* is recommended by Ausspitz, who advises us to do as little as possible in the acute form. In this we differ from him, for, although we may not obtain a sudden cure, still the treatment is of great relief to the patient:

℞.—Flor. Zinci, ʒij;
Pulv. Alum.
Amyli Pulv. āā ℥j. M.
Ft. Pulv.

The powder is to be dusted over the affected parts with a camel's-hair brush.

FURUNCULOUS ABSCESS OF THE AUDITORY CANAL.

This is not a frequent affection, but varies with the several seasons, being more prevalent during mild, and consequently damp, winters.

Roosa, in a report of five hundred cases of aural disease, gives only eight of furunculous inflammation of the external auditory canal. In a still more recent report, of four hundred

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[*] Prof. Roosa, Medical Record, p. 79, April 15, 1871.

and ninety-four cases of diseases of the ear, there were fourteen cases of furuncular or circumscribed inflammation of the external auditory canal.*

Schwartze found thirteen in five hundred and fifty-four cases of disease of the ear.† Pagenstecher,‡ seven in two hundred and twenty cases; and Gruber§ counted thirty-two out of seven hundred and seventy-five, observed in his clinic for diseases of the ear. These statistics from eminent authorities will furnish some aid in forming an estimate of the frequency of this painful affection.

Out of six hundred cases treated by the author, there were thirty-nine of furunculous abscesses. These varied markedly with the influence of our ever-changing temperature of climate, and in position in the course of the auditory canal.

By reference to the anatomy of the external ear, it will be readily noticed that the tissues in which this abscess occurs are tense and unyielding.

It is impossible at all times to distinguish precisely how deeply the inflammatory action has extended. The starting-point is usually one of the hair-follicles in the external portion of the auditory canal, or in one of the sebaceous glands; hence the various positions which they occupy in the canal.

Etiology.—The etiology of furunculous abscess is not well established.

Prof. Roosa states that in seven of the eight cases reported, the abscess occurred in persons who were not in good general health.

According to Von Tröltsch,‖ furuncles of the auditory canal appear at any time in life, and in the most different constitutions. They often occur as complications of otorrhœa, when the ear is very frequently syringed, and also when the affection is left entirely to itself. Hagen* states that he has observed them in patients from four to sixty-two years of age, and that others have observed them in nursing children.

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* [illegible] Jour., No. 3, Aug. 1868.

† [illegible]

‡ [illegible] Ohrenheilkunde, von H. Schwartze. Wurtzburg, [illegible]

§ [illegible] Ohrenheilkunde, Berlin, No. 9, Sept., p. 128.

‖ [illegible] on the Ear. Translated by D. B. St. John Roosa, N. Y. 69, [illegible]

Rau† "thinks that this is not a frequent affection in children, and appears like aural catarrh, about the time of teething."

Sex seems to have but little influence, although the weight of authority believes this abscess occurs more frequently among females than males. There seems to be no doubt of some predisposition to this affection among females who suffer from menstrual disturbances, and at the menopausis, as well as in phthisical cases.

Wilde‡ states that "these abscesses occur oftener in females than in males, and I am induced to think they appear oftenest in persons in the higher classes than in the lower, and also that they seem to be induced by some peculiar state of the constitution, and very often appear either as a sequela to or a concomitant of furuncles on other parts of the body; particularly about the neck."

There can be no doubt that irritants, injuries, cold, foreign bodies, collections of wax, constantly picking of the ears with pins, needles, toothpicks, etc. are frequently the exciting causes of these abscesses.

Von Tröltsch, Schwartze, and Von Hagen have observed these abscesses frequently after the use of alum washes for the ear for deeper complications, as catarrh of the membrana tympani, etc. Dr. Roosa is inclined to doubt the peculiar influence attributed to alum solution. The author has observed the tendency of astringents to produce them when used in too strong solution.

Symptoms.—The symptoms of this affection vary according to the position it assumes. As a furunculous abscess, having its seat either in a hair-follicle or ceruminous gland, it has in its centre a circumscribed "core," which must be discharged before healing will be accomplished. The pain will be more or less modified by the tissues involved, so that the extent of inflammation will not serve as an index of pain. Cases occur in which the pain is most excruciating ; in others it is scarcely noticeable until the abscess is formed. This difference is fully accounted for by the peculiar formation of the lateral section of the meatus, it being composed partly of cartilaginous walls, and a part consists only of membranous tissue, having an osseous margin, while it is also contiguous to soft parts. Furthermore, on the upper wall, a gusset-shaped piece of integument extends to the osseous wall of the canal, and has just as dense connective tissue as any other part, as well as glands and hairs.

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* Praktische Beiträge zur Ohrenheilkunde, von Dr. R. Hagen, No. III. Leipzig, 1867.

† W. Rau, Lehrbuch der Ohrenheilkunde. Berlin, 1856.

‡ Wilde, Diseases of the Ear. Phil., 1853, p. 192.

If, now, furuncles should occur in a position where inflamed swollen connective tissue cannot extend itself, and quickly reaches a firm, unyielding basis, viz., the bone, the symptoms depending upon tension of the connective tissue will be much severer. If we reverse the case, such follicular abscesses will be little noticed if situated at the entrance of the auditory canal, or in similar favorable localities. The pain in the beginning is often intense, and, in some instances, increases at night. In milder cases it is, however, scarcely more than a burning, itching, sticking pain, accompanied with fever, loss of appetite, loss of sleep, etc., showing how fully the whole system is affected. Often the acts of chewing or speaking give intense pain. In other cases severe pains radiate from the troublesome centre to adjacent parts, and make the slightest movement of the ear impossible on account of the intense pain. Patients thus affected often persist in describing their pains as neuralgic, and are often encouraged in this by their physicians, to such an extent that it is difficult to persuade them to allow the ear to be examined. So sensitive does the auditory canal become, that they are fearful least the light from the mirror should cause additional pain. The slightest touch with a probe, on the point of the abscess, is exceedingly painful, and this manœuvre will often aid in diagnosis. They may be seated anywhere around the external meatus, but occur more frequently in the anterior and posterior wall than in the roof or floor. They vary in size, with a broad base, and their color is but little altered from that of the skin, sometimes being slightly reddened, especially immediately over the swelling. This swelling is not always well defined, and the partial closing of the canal renders it difficult to demonstrate the actual position of the abscess; and when it is situated in the external portion of the canal, the cellular tissue of the external ear becomes at times involved, and the meatus becomes entirely closed.

Without doubt, there is more or less congestion of the membrana tympani in most cases, as is shown by the sense of buzzing and tinnitus.

The hearing in these cases is seldom much impaired, unless, perchance, the abscess be situated near the drum of the ear, or where the swelling materially diminishes the calibre of the external auditory canal.

Course and Termination.—Resolution may sometimes take place without discharge of pus, says Von Tröltsch. Generally, if left undisturbed, the formation of the abscess progresses tediously and painfully, lasting from two to eight days. The symptoms of pain increase in direct ratio to the duration, until, at last, an abscess is formed. A peculiar exudation at first covers the surface of the abscess, then the tissues give way, and only a few drops of pus with a little blood is discharged. The tormenting pain ceases, and the patient feels a strange sense of relief. Finally, the "core" is discharged, and the opening heals unless another one forms, following rapidly in the steps of its painful predecessor; and frequently the second abscess is forming whilst the first is discharging.

Diagnosis is not difficult if the symptoms already mentioned exist, and yet mistakes occur. In cases of complaint of pain in region of the ear, it is always best to examine the whole canal with direct or reflected light, and explore its whole length by gentle touches of a silver probe. Usually some point of excessive tenderness will be found, thus locating the seat of the abscess.

To illustrate the errors that may arise in cases of this kind, a case from the practice of an acquaintance will serve:

June 20, 1869, Miss B., aged nineteen, applied for advice, and gave the following account: Two days ago, feeling a tingling and itching about the ear, she used a pin to scratch the ear. In doing so she lost her hold of the pin, and she thought it had fallen into the ear; but as it gave her no annoyance it was forgotten. Three or four hours elapsed, and her attention was again arrested by a burning and tingling sensation in her ear, which soon became painful. Remembering the pin, her parents were consulted, and by a light from a lamp it was concluded that the pin could be seen, and various attempts were made to dislodge it by the aid of needles, scoops, etc. The pain became intolerable, and, full of alarm and anxiety, a physician was summoned, who confirmed the diagnosis of patient and parents, stating that the pin had turned, and the head only was visible; also that an operation would be required for its removal. After several hours of suffering, she was induced to consult the physician who gave me the particulars of the case. A circumscribed abscess was found on the floor of the meatus, just at the curve of the canal. The treatment was rapid and effective: puncturing the abscess and application of warm water gave immediate relief.

Prognosis, with reference to each individual abscess, is favorable; bad results seldom follow them, although periosteal inflammation has been occasionally induced by the inflammatory action attendant on their development. They sometimes induce, as a consequence of their successions, thickening of the tissues of the canal and limit its calibre. The saddest feature of these cases is the tendency to recurrence. Sooner or later they come in succession, each one bringing its train of tormenting painful symptoms.

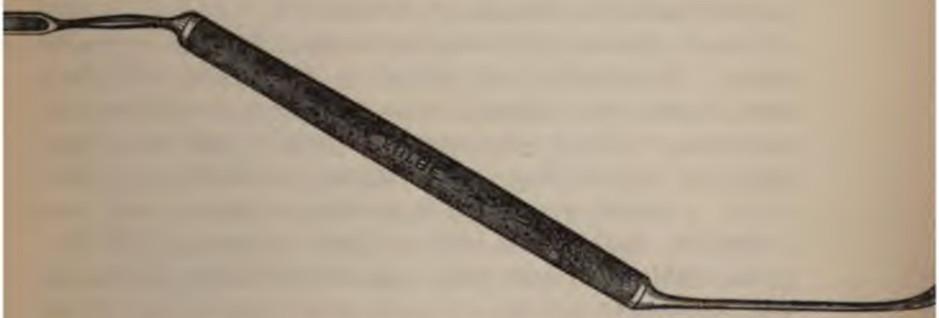
"Von Tröltsch reports a case where the patient, for twelve years, with intervals of ten weeks, and at the highest of two months, suffered from such furuncles, now in one ear and then in the other, and with which there was great febrile disturbance, so that at each attack he was obliged to remain in bed."

Sometimes the inflammation extends to the deeper portions of the connective tissue, also to the tissues covering the mastoid process.

Treatment.—The principles of treatment can be summed up in a few words. Incise promptly, favor suppuration and discharge of core, and prevent recurrence by all the means available. Heat and moisture favor suppuration, and may be applied in various forms. The author has found the hypodermic use of morphia and the hydrate of chloral exceedingly valuable as palliatives, especially the latter, which is given in from five- to fifteen-grain doses until the pain is relieved.

So important is early incision that patients who have suffered from the tedious course of the abscess, and subsequently on recurrence of the disease been relieved by early incision, will give up the prejudice against the "horrid knife," and even request its use. So soon as the incision has been made, the ear should be filled with warm water, and the part kept constantly in a warm bath for at least half an hour, or better still, "steam" projected into it by means of the atomizer. If the core can be distinguished, gentle pressure with Daviel's scoop, or Gross's instrument for removing foreign bodies, will facilitate its escape, or Hagen's blunt bistoury, with spoon for evacuating the abscess. (See Fig. 58.)

Fig. 58.



Make your incision at once, without any further ceremony, for often the fear of the knife is greater than the fear of the pain. The knife should be as sharp as a "cataract" knife; for, if surgeons were more careful about keeping the edges of their instruments keen, there would be less pain, and, consequently, less fear. Do not wait until Nature has done the work, until pus has formed, but cut exactly upon the painful spot; seek only to relieve, and your patient will thank you. When it is over, immediately favor the discharge of blood by the continued injection of warm water. Here Clarke's douche is invaluable, and sufficient injection of warm anodyne fluids should be used to keep the canal clear of pus, blood, cerumen, and epithelium, as they accumulate.

What shall we do to prevent recurrence of these abscesses? To this question there are many answers. Nitrate of silver, preparations of mercury, syringing, oils of fruits, nuts, and animals, and even petroleum, have all had their stanch advocates, and yet recurrent abscesses are as frequent as ever.

We should not, on this account, abandon a case because specifics have failed, but rather seek to modify our treatment to each case.

Should the patient refuse to have the knife used, anodynes must be resorted to. In prophylactic treatment the author has found the best results follow the use of iodide of iron, either in syrup or Blanchard's pills, or pill iodiform et ferri, especially in strumous cases. This must be persevered in for several weeks. The following are a few of the cases treated, and will serve to illustrate the above:

CASE I. *Abscess of the external meatus.*—Miss M. C., aged thirty. September 19th, opened it, and applied heat and warm water. Is a delicate lady; has not had an attack for four years, at which time she had them in both ears; was under my care at that time. Internal treatment, syr. ferri iodidi, in twenty-drop doses, three times a day.

Miss H., aged twenty-two, a cousin of Miss C., had one at the same time, four years ago, and the same treatment was successfully applied.

CASE II.—A few days after, Mrs. G., aged forty-five, called, and was suffering from the same affection. It had opened, after three days' suffering, she having lost the hearing in her left ear by an operation performed by a surgeon of this city in removing a tumor when a child. Introduced the spoon end of a tube and removed about half a teaspoonful of pus;

and directed a warm-water dressing, and the same internal treatment as the previous cases. This abscess was situated about the centre of the canal.

CASE III.—September 29th. Mrs. L., aged forty-five, has been suffering for some days with an abscess in front of the tragus, but pointing inwards. In spite of narcotics, has given her most intense pain. She has a feeling or sense of stuffing, buzzing, and throbbing in the ear, accompanied with fever. The inflammation spread over the whole malar region. She has poulticed it with flaxseed-meal and bread-and-milk, but it will not discharge. Her husband, therefore, brought her for advice. I at once opened it by a free incision with a tenotomy-knife, and a full teaspoonful of laudable pus was discharged. Directed the free use of warm water; also a solution of plumbi acetas et opii to the part. As her health was somewhat broken down, I gave her the syr. ferri iodidi, twenty drops every three hours, with nourishing diet.

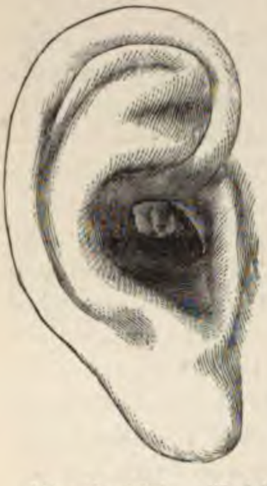
The above cases yielded kindly to treatment, and serve as illustrations as regards position of such abscesses in the external auditory canal.

Osseous tumors in the auditory canal are not frequent, and these cases will illustrate the subject. Toynbee's treatment consisted in alterative doses of blue mass; the surface washed with a solution of nitrate of silver (ʒj to ℥j) every fourth or fifth day, and afterwards every seventh day; in another case, tincture of iodine was applied to the surface of the tumor, behind the ear, and four grains of iodide of potassium were given three times daily for between two and three months. This latter treatment was found successful in the following case of tumors of the auditory canal and deafness:

F. S., Esq., aged fifty-five, born in England, residence, Walnut Street, Philadelphia, consulted me on March 5th, 1871. His general health was good, but has been deaf in his left ear for a long time, and could not hear his watch, even when pressed close to that ear. He has also become suddenly deaf in the right ear, and can only hear a watch when close to the mastoid process, not distinguishing a loud-ticking watch when pressed on the auricle. He states he had gout several years ago, and, when a boy, an eruption outside and inside of the ear, with more or less discharge. He had been under the care of a gentleman of some distinction in London, who advised him to have nothing done with the left ear, as no improvement would be likely to ensue. This was ten or twelve years ago, and at present he has in his neck a cicatrix of an old abscess. His daughter was under the writer's care for deafness, and was relieved, two years since; and he has had two other children, both of whom died of tuberculosis of the lungs.

On examination of the right ear, found the lining membrane congested, and near the membrane tympani, a gouty deposit the size of a large pea, projecting half way across the meatus. (See Fig. 58.) The membrana tympani had a sodden and white appearance, and numerous scales of dark-colored epithelium were removed by washing out the ear. The whole space was contracted and dull from an old discharge. The Eustachian tube of that side was not opened by the Valsalvian method, so the Eustachian catheter was introduced and the tube well opened; but no decided improvement of the hearing followed. Applied tincture of iodine to the bony tumor, and ten-grain doses of iodide of potassium internally three times a day.

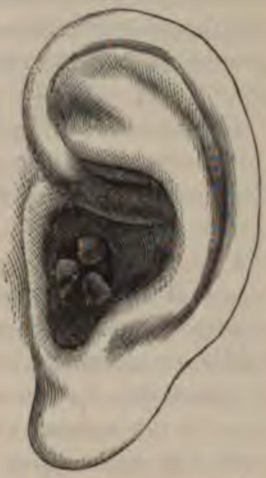
Fig. 58.



March 10th. Exhibited the case to Dr. Knight and Prof. Meigs. The latter suggested that the same condition he had no doubt would be found in the interior of the ear, fixing the stapes by osseous connections. After several days' careful washing with a slight astringent and carbolic acid, the writer employed Siegel's aural speculum, and exhausted the air carefully until he felt the motion, but the only improvement was hearing the watch by the auricle. Having so little success with the left ear, he resorted to the other, and found a collection of hardened dark cerumen; this was softened for three nights with a warm alkaline solution. On the

13th the ear was carefully washed, and the dark-brown mass removed, much to the patient's surprise. On examination of the membrana tympani, it was a dull white (no malleus seen, nor bright spot), membrane very concave, and three osseous (see Fig. 59) tumors were found near it. No improvement was made after having air passed into the middle ear, except that for seven days he was able to hear the watch when pressed close, but he observed it was faint. He could also hear the human voice much better, and in the case of a watch, it has been years since he has heard one in that ear.

Fig. 59.



March 24th. Applied to tumor of left ear a solution of nitrate of silver, seventy grains to the ounce of pure French glycerine, limiting it so as to remove the epithelium. Opened the Eustachian tube by the catheter, desiring him to practice the Valsalvian operation on entering a warm room and not to return for four days.

March 28th. My patient came this day, says simply he is so much better that he is satisfied with his hearing, that it is quite restored. On testing it by my watch, he heard it one foot off, and the voice several feet; his right ear is also much better, and he can hear the watch and the voice several feet.

May, 1871. The improvement is permanent.

OTITIS EXTERNA DIFFUSA.

This is an inflammation of the external auditory canal, affecting only the cutis and cutis vera, but it may extend to the outer surface of the membrana tympani, etc.

It is generally an acute affection, but should it become chronic, it may involve the periosteum; if this is the case, we have then a general *otitis*, and pus may be found in the middle ear, and then we class it as otitis interna. The auditory canal, no matter how near the membrana tympani, is not lined by a mucous membrane; we therefore consider both Toynbee and Politzer as not teaching sound doctrine by speaking of a catarrhal inflammation of the auditory canal. The term *catarrh*, according to a proper nomenclature, pertains only to affections of the mucous membrane; hence its use for inflammations of the external auditory canal is not proper, and aural catarrh should only be used for the middle ear.

Causes.—In our opinion it occurs chiefly in scrofulous and tuberculous children, and frequently alternates with an affection of the eye; we also fully agree with *Rau* that it always accompanies the dentition of certain children, cutting the hair, and applying cold water to the head, with certain forms of the exanthemata, as measles, chicken-pox; while small-pox and scarlet fever almost always produce otitis [illegible]

Symptoms.—In almost every instance it is ushered in with [illegible] the patient [illegible] ear-scoop; or the [illegible] pain, is unable [illegible] increases towards [illegible] the patient from [illegible] an attempt [illegible] the deep-seated [illegible] showing that [illegible] pres- [illegible] the pain is expe- [illegible] inflammation being [illegible] in the [illegible] very thin. [illegible] matter [illegible] made. [illegible] by [illegible] these must be removed with great care, as we frequently find the membrana tympani so soft as to be easily injured. Therefore these scales should be washed out by means of Clarke's modification of Thudichum's douche, a continuous gentle stream, the water being very warm, as rude syringing is also very painful to the patient. In the subsequent examinations it will be found that the canal is so swollen that great care is necessary in introducing the aural speculum each day, so as to see the progress of the disease. The amount of the impairment of hearing depends upon the closure of the canal, and also upon the amount of the membrana tympani involved.

Prognosis.—This will depend upon the constitution of the child, and also upon the cause producing the disease; but as a general rule the result is favorable.

Treatment.—In the acute form, active purgations, free leeching, with warm spray of solutions of opium, hops, or poppy-head. If a child, a warm poultice of ground flaxseed and elm bark over the whole side of the face, and a dossil of cotton or lint, saturated with an anodyne lotion, in the ear, will give great relief. In the second stage, when there is a free discharge and little or no pain, then we may resort to a solution of the biborate of soda, hyposulphite, or bisulphite, with water and glycerine; with counter-irritation, by an ointment of iodine and iodide of potassium, with lead or mercury, to remove the deposits in the ear. Nothing cold should be applied, but every application should be warm, or about the temperature of the skin.

Long-continued poulticing we consider injurious, but in the very early stage one good poultice quickly produces exudation and free discharge, also a cessation of tension and pain in this form of otitis externa. I fully agree with Von Tröltsch that poultices should not be applied in deep-seated inflammatory affections of the ear in which there is disturbance of the brain, as they assist in producing profuse and wearying discharges. We now come to the third stage of these affections, and we call these cases subacute, and they are generally found among the poor out-door cases which attend our clinics; these cases require a solution of sulphate of copper or nitrate of silver applied by the surgeon's hand to the granular surface, and a wash of sulphate of zinc or hydrated chloride of aluminium, two gr. to ℥i of water, which the patient can use at home, filling up the ear with it, warm, and using a plug of cotton, and allowing it to remain from ten to fifteen minutes, repeated twice a day until the discharge ceases. Great care must be exercised in cold weather for fear of an acute attack supervening on the old one by taking cold, which frequently involves the periosteum, or mastoid cells, or, passing to the cerebellum, causes the death of the patient. In very cold weather the ear should be protected by a cap or pledget f cotton, and I am of the firm opinion that the hair is the natural protector of the ear, and it never should be wet and then allowed to hang in damp folds around it; nor should it be cut very close during cold weather. In warm weather no protection is required for the ears, but the use of an abundance of fresh water to wash the ears, neck, and front of the chest, followed by wiping the parts perfectly dry.

CHAPTER XI.

OTITIS MEDIA PURULENTIA, ACUTE, SUBACUTE, CHRONIC, AND HYPERTROPHIC (SUPPURATION IN THE MIDDLE EAR).

THIS affection is usually induced by cold air or water, introduced through the Eustachian tube, or by a perforation in the membrana tympani, and in some instances caused by the feet being exposed to the cold. In several cases we have known it to occur by a wave striking the ear in sea-bathing, or a sudden plunge or dive in very cold water. It is also a sequela in various forms of fever, hooping-cough, measles, and during the irritation of dentition.

Symptoms.—Pain in the ear, intermittent in character, commencing at night, and disappearing in the morning; after a time the pain is constant and very much increased in intensity as it reaches the vicinity of the middle ear, involving the membrana tympani and osseous structures. It also extends to the head and neck, attended by fever and a furred tongue. As soon as pus is formed there is more or less of a creep, and in some instances a decided chill. It is always accompanied by deafness, noises, throbbing, with fullness, and soon after is followed by a discharge; first a faint moisture, then a cream-like fluid, and at last an abundant purulent excretion. In young children unable to express their feelings, the only indication is a decided and persistent screaming for hours, which is often confounded with the symptoms of colic, and our diagnosis should be determined by exclusion. Pressure over the antitragus will often confirm the result by the pain which the child suffers; but our only sure guide will be a slight discharge on the pillow in the morning. This discharge has a peculiar odor, resembling decayed cheese. In an account of an interesting case reported by

Prof. H. Knapp,* the purulent inflammation was caused by the use of *cold water*, by means of Weber's nasal douche, confirmed in cases reported by Roosa and Moos. It is explained thus: the cold water is more apt to cause involuntary swallowing than warm, by opening the Eustachian tubes. Besides the peculiar nature of its origin, the above case of otitis media purulentia was very remarkable for a symptom not much noticed in such cases: viz., *double hearing with both ears.* Tröltsch and Politzer mention its occurrence; Moos records several cases in his "Klinik der Ohrenkrankheiten" (for notice of which see Nervous Deafness). In the case of Prof. Knapp, the meatus was swollen and red, the membrana tympani injected, soft, and projecting into the meatus, and after a time becoming a greenish-yellow color, with perforation.

Prognosis.—Generally favorable unless in case where the blood becomes altered by scarlet, typhoid, or typhus fevers, or in scrofulous or tubercular cases. In the first class, or in healthy individuals (if the case is promptly treated), resolution takes place, and after several weeks the discharge ceases, the membrana tympani heals, and the hearing is restored; but if, on the contrary, the case is neglected, or the constitution is impaired or altered, it passes into chronic otitis media with enlarged perforation. We shall illustrate the treatment by a clinical case.

CASE I.—Mrs. Margaret B., aged forty years, a strong, healthy lady, had been exposed when the thermometer was 13° Fahr., her head being protected with the slight covering of the present fashion. She was out-of-doors most of the day of December 13th, in the evening complained of pain and heaviness in her head, with a decided chill. On the 14th, she had a discharge of serum from the nostrils, with slight relief to the head. On the 15th, the discharge from the nostrils was mucus mixed with blood, which continued also on the 16th, and then suddenly ceased, when the face and gums began to ache. Application of hot water, with warm flaxseed poultices, relieved the pain in the head. On the

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* Archives of Ophthalmology and Otology, by Prof. Knapp and Moos. New York, Wm. Wood & Co., 1870, p. 365.

17th, she suffered from great pain in the ears, and which was allayed by steaming the ear with hot water. On the 18th, the ear and throat began to discharge, and the pain returned at night with renewed violence. On the 20th, the left membrana tympani was perforated. Upon that side I could see the point where the perforation was about to take place, and at my visit on the following day I *saw* the *point* of perforation with the bubble of air under it.

Treatment.—A blister in front of the ear, calomel and morphia at night, and a wash of glycerine and water, equal parts, with ten grains of sulphate of zinc to the ounce, which she continued to use until the 25th. During the last week of treatment the wash was changed to two grains of nitrate of silver to the ounce, each, of glycerine and water, with use of the air douche. Feb. 1st, patient able to resume her usual occupations, and after some weeks the discharge gradually reduced, the perforated membrane was healed over, and her hearing almost as good as before her attack.

In this affection we have several symptoms which we have in acute inflammation of the membrana tympani. In the class of patients which present themselves at our clinics with this affection of the ear, there is almost always a feeble condition of the system, accompanied by no fever, and but slight pain; it is therefore properly termed *otitis media purulentia chronica*, or otorrhœa, with perforation of the membrana tympani.

The first appearance which we will always notice is an irritable red meatus, and when the ear has been carefully washed out, so that we can, with more or less effort, see the character of the opening in the membrana tympani, it will be almost invariably found not healthy or ready to heal. The next consideration is, what keeps the membrane open, and why is it not ready to heal, as in the acute form in private practice? It is because there is disease in the middle ear, vascularity, or a granular condition, or some accumulation of pus or mucus not removed, producing an irritation, and preventing permanent cicatrization. The external meatus is usually found filled with pus or mucus, which causes the patient a feeling of fullness. After its removal, the opening is seen in the membrana tympani, causing a whistling sound when the nose and mouth are closed and we blow outwards or expire. The hearing is always defective, especially if the Eustachian tube is not open. *That* we can determine by taking a mouthful of water, holding it, then closing nose and mouth, and making the effort to swallow; or, a more certain way is by the use of the Eustachian catheter and otoscope, or Politzer's air douche. The patient's voice is almost always affected, and becomes nasal, and there are symptoms of irritation in the nose and throat. When the meatus is carefully examined, it is found inflamed, and covered with softened scales of epithelium, exposing the cutis vera, with here and there masses of dried pus or mucus, with hairs, and, in many instances, small masses of yellowish wax. This chronic affection, owing to the exposure of the mucous membrane of the middle ear, by the perforation in the drum, is very liable to frequent relapses into the subacute stage; we must also remember how very near this inflammation is to the brain when it gets beyond the barrier of the membrana tympani, and act always with caution.

Prognosis.—This will depend largely upon the severity of the attack, the general health of the individual, and the duration of the perforation.

If the attack has been one in which there was much mental disturbance, severe or protracted fever, convulsions or blood disease, the prognosis is very unfavorable for decided improvement in hearing, although the discharge may cease and the perforation heal. If the individual is of a scrofulous or tuberculous diathesis, the healing of the perforation rarely occurs, but rather tends to increase, until entire destruction of the membrana tympani takes place, with loss of the small bones. Another termination is in otitis interna, or pyæmia, which finally results in death. If the perforation is large, and has been of several months' duration, it is very difficult to heal even in a healthy person. Another important agent in the prognosis is the character of the discharge: if it is mucus alone, or even muco-purulent, the prognosis is very favorable. If it consists entirely of true pus of a yellowish tint, the prognosis is not as favorable, and indicates a higher grade of inflammation; while if the pus is sanious, serous, ichorous, or scrofulous, the prognosis is very unfavorable. The prognosis, as before stated, in purulent inflammation of the middle ear is always grave in character, although statistics show that the actual number of deaths is not as alarming in proportion to the cases. There exists in every case a liability to sudden extension of the inflammation to the inner ear, causing cerebral complication, which it is impossible for the physician always to prevent. This complication, with that of the mastoid process, will lead to caries and necrosis, especially in youth and middle life. Gruber's advice to the surgeon in all such cases is to inform the family of the dangers which may arise, in order to save his reputation, in case of the sudden outbreak of these symptoms.

We find the majority of general practitioners not well informed of the nature of chronic suppuration of the middle ear, confounding it with chronic suppuration of the external auditory canal, under the old term of "otorrhœa," and rarely ever endeavoring to distinguish the difference by ocular inspection with the aid of proper instruments. Indeed, but few can tell a purulent otitis of the middle ear, with perforation of the membrana tympani, even if shown it, so unaccustomed are they to take the trouble to understand its nature. The statistics of writers on diseases of the ear, and the reports of eye and ear infirmaries and hospitals, show that, instead of external disease of the ear, we have in the majority of cases a most serious disease of the internal ear:

	External Otitis.	Chronic Suppuration in Middle Ear.	Total.
New York Eye and Ear Infirmary, 1869 . .	46	324	370
Brooklyn Eye and Ear Hospital, 1869 . .	17	85	102
Ophthalmic and Aural Institute, 1869 . .	19	84	103
*Schwartze's Statistics, 166 cases . . .	15	39	54
†Roosa's Statistics, 500 cases	11	111	122
Turnbull's Statistics, 600 cases, Howard Hospital	30	99	129
	138	742	880

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* Vide Archiv für Ohrenheilkunde, B. I.

† Roosa, New York Medical Journal, 1869.

In summing up these figures, it will be seen that there were 742 cases of chronic suppuration of the middle ear to 138 cases of chronic inflammation of the external auditory canal. We might state, in this connection, that we received this day (Oct. 31st, 1870) an illustration of the want of knowledge of the general practitioner under this head. From the neighborhood of this city, a little boy, aged eight years, came to us with chronic "suppuration of the middle ear," affecting both ears. He had been under the care of a most respectable, intelligent, general practitioner, a graduate of one of our best institutions, and yet he never knew that the little fellow had perforation of the membrana tympani, although he had been treating him for seven years and two months, almost the entire life of his patient. According to the statement of the mother, he had never washed the ear or examined the boy with an ear speculum or by reflected light, but gave her a wash, blistered behind the ears, and trusted the cleansing to her.

The first and most important matter in the treatment of acute and chronic suppuration of the middle ear is to wash it out with warm water, to which is added one grain of biborate of soda to each ounce, by means of Clarke's modification of Thudichum's douche, without injury to the delicate perforated membrane.

If there is pain, heat, swelling, and redness, indicating subacute inflammation, we must deplete, either locally or generally, or both; but as a rule local depletion is all that is necessary. We prefer leeching, by means of Swedish leeches, applying them as close as possible to the ear; if these cannot be procured, we employ American, in the proportion of six to one Swedish; if neither can be had, we should then resort to very small cut cups or the artificial leech. After the depletion, Canton flannel cloths or patent lint, wrung out of hot water and covered with extra cloth or oil-silk, will materially assist the flow of blood and give relief to the pain in the ear. If these means fail to subdue the pain, resort to morphia sulphatis, either by the mouth or hypodermically, commencing with one-sixteenth of a grain, and gradually increasing to one-eighth or one-quarter or even one-half of a grain, at intervals of three hours. If these means fail, we try the hydrate of chloral dissolved in lemon, orange, or ginger syrup, beginning with fifteen grains every three hours, largely diluted with water; viz., two ounces of fluid, and increasing the chloral to thirty, forty, or even fifty grains, or combining the morphia and chloral, as they will sometimes act better than either would alone. After the patient has been relieved of the acute pain, and has had some rest, and yet continues to be disturbed with distress in the head, with a hard pulse, we use the foot baths, adding mustard or common salt, and placing the feet of the patient in moderately hot water, adding gradually water of increased temperature as the patient is able to bear, until relief is obtained. If these means fail, we administer an active purgative of calomel, rhubarb, and ginger, or a saline mixture, as the following:

℞.—Mass Hydrargyri, gr. x;
Extractum Hyoscyami, gr. i;
Magnes. Calc. (Husband's), ʒij;
Aq. Menth. Pip.
Syr. Simplex, āā ℥j. f. Misce.
S. To be taken at one dose, or divided into two.

This relieves the bowels, acts on the liver, and depletes from the intestines with signal relief. In most of the subacute attacks the discharge for the time ceases; and relief is always experienced when it flows freely. Von Tröltsch recommends filling the ear with lukewarm water, and leaving it in the ear from five to ten minutes, the patient at the same time lying on the other side. We have found also relief from the use of the warm cloths frequently renewed; or in some instances, the elastic bag of Chapman; or in other cases, dry heat by means of a bag of common salt.

After the subacute symptoms have disappeared, we must diminish the discharge and give nature an opportunity to act, but we must not resort to violence; therefore we still recommend the use of the douche or post-nasal syringe to wash away the excess of secretion, for it is bad surgery to remove all the covering from the surface of an ulcer, or even an exudation, as we then bring the air and other irritating substances in contact with it. Clean it by allowing the fluid to flow over it, not to rub it off. One of the greatest evils is the resort to astringents too soon, and it is better for some time to employ the biborate of soda, or the bisulphite or hyposulphite, a few grains in warm or tepid water, so as to remove whatever would interfere with the healing process; if there is much odor, carbolic acid and water, ʒi to ℥iv. When the parts become pale or flabby, then it is time, and only then, to give a slight stimulation, as we would to an ulcer; for instance, one or two grains of the acetate of zinc with the one-twelfth or one-sixteenth of a grain of the acetate of morphia, dissolved in the douche three times a day, and allowed to remain in the ear. Opening the Eustachian tube is always necessary by the catheter, and gently passing air through so as to be able to see a drop or two of liquor forced through the cotton, or by resorting to Politzer's method, we have a current of air to assist in cleansing the cavity of pus, mucus, altered lymph, or even blood. This will also assist in bringing the necessary stimulation and wash in contact with the altered mucous membrane of the cavity of the tympanum.

In the case of very young children, Mr. Hinton suggests the use of a piece of small rubber tubing tipped with ivory or bone instead of the air-bag, and this we have used, and the operator is to blow gently the instant the patient swallows. In little children the inflammatory stage is usually a short one, and the most disagreeable feature about the discharge is the odor, which is soon removed by the use of the chlorine-water, prepared by passing chlorine gas into water, or dissolving a portion of the chloride of lime, one drachm to half a pint of water, and filtering it. The writer usually dilutes this in the proportion of a teaspoonful to a cupful of tepid water, gradually increasing it to a tablespoonful; after a time this is replaced by alum, in the proportion of gr. ij–v to f℥i of water; using morning and evening half a teaspoonful, warm, and allowing it to remain ten minutes, with the ear closed by cotton.

As we frequently find that after a time no improvement takes place, we then have to resort to a stronger stimulant, namely: the nitrate of silver, or sulphate of zinc, or copper, in strength of twenty, thirty, forty, and even sixty grains to the ounce, applied by means of a very delicate piece of sponge, or cotton, attached to a long, slender wire of aluminium, or silver. The advantages of the sponge over the cotton are that it retains its solution until pressed to the part; at the same time none of the cotton fibres are left in the ear. The delicate sponge is also useful in removing particles of epithelium, pus, mucus or altered cerumen. With the use of the mirror we can also touch vegetations, and limit them to the spot. We have given up the use of the solid stick, as we found we could not limit it, and, in some instances, it destroyed too much by its caustic action. It is true we can control it by the chlorine-water, or a solution of common salt.

Politzer* states: "Vegetations in the external meatus, on the membrana tympani, or the promontory, which, so long as they remain, keep up the otorrhœa, must be removed, when they can be easily reached, or destroyed, by touching with a concentrated solution of muriate of iron, or, if *hard*, by nitrate of silver in substance." He employs for the latter a simple metallic wire of the length of a sound, bent at right angles at the middle, immersing the point several times in nitrate of silver, melted in a little porcelain cup, till the caustic has hardened upon it in the form of a little ball.

An equally good authority, Wilde,† states: "After a long and fair trial of several means proposed for healing apertures in the membrana tympani, I have come to the conclusion that there is nothing like nitrate of silver. It will not, however, answer to thrust a stick of lunar caustic, fastened to a quill, down the meatus, for the purpose of touching any part of the membrana tympani; to be used with effect, the escharotic should be applied upon the extreme edge of the aperture, or rather within the ring of the opening, every second or third day, so long as the part seems inclined to close; *but the moment we perceive it enlarging*, a day or two after the application, we must desist. As it is not always possible to reduce a pencil of nitrate of silver to the requisite degree of fineness, I have for several years past been in the habit of pointing probes and other instruments used in minor surgery, with nitrate of silver attached to them in the following manner: a portion of the caustic is to be melted to the boiling-point in a small silver or platina ladle, such as is represented at Fig. 96, held over a spirit-lamp. When the caustic has become quite clear, the point of the probe, or instrument, to which it is to be attached, should be heated in the flame of the lamp, and then dipped into the fluid caustic several times, until a sufficient quantity is taken up. The instrument figured at Fig. 97 will be found very convenient for applying nitrate of silver to any surface within the meatus. This porte-caustic is about six inches long, and consists of a silver tube, cut spirally for three-fifths of its length, and having an aperture in the side, or a hollow at its end. When about to be used, its extremity should be coated with caustic, as already directed. The elastic spring prevents any injury to the ear from the starting of the patient, and can also be bent, so as to be applied with ease to any part of the auditory canal. When granulations sprout from a perforation in the membrane,—which is very rare, unless the rupture occurs immediately adjoining its edge,—this method of applying caustic will be found very convenient; but the writer cannot state that it has been very effectual, in his hands.

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* The Membrana Tympani in Health and Disease, Translation, p. 130. New York, 1869.

† The Nature and Treatment of Diseases of the Ear, American ed. Phila., 1853, p. 292.

Before concluding this part of our subject, we must not omit the importance of constitutional treatment in this disease, by means of tonics, alteratives, cod-liver oil, extract of malt, iodine, quinine, and mercury, and also means of counter-irritation by blisters, croton oil, tincture of iodine, and, in some rare cases, the actual cautery; these are all necessary measures of success in removing the discharge. As the tables of our German friends show better success in treatment of this and one or two other forms of diseases of the ear, I have given the views in extenso of Dr. Gruber, one of the most recent writers upon this subject, holding a distinguished position in Germany.

"*Treatment.*—Since not merely the faculty of hearing, but even the life of the patient are in the greatest danger, the utmost circumspection and energy should, as a matter of course, be exercised, and with the best medical experience.

The least neglect may destroy the life of the patient, while a skillful and timely action will be followed by the most happy results. The treatment is mostly symptomatic, and consists in preventing the inflammation from spreading, especially to deeper parts, and in endeavoring to save such parts as have been already attacked. As much as possible the treatment must be antiphlogistic, care being taken to avoid those means which, by impeding the reflux of the blood, increase the hyperæmia of deeper parts. As long as the inflammation is at the stage of hyperæmia, as well as when the patient is suffering extremely, suppuration having occurred, local bleeding may be employed. In the robust, where there is considerable cerebral pressure, venesection will be most serviceable.

" The leeches should be applied around the ear, especially over the mastoid process. It should be remembered that as the depletion is not directly from the inflamed part, and as it has for its object the mitigation of the hyperæmia of the brain and its membranes, to be effective, it should be copious, and the after-bleeding sufficiently maintained.

"As a matter of course, the depletion must be repeated during the course of the disease, as often as the symptoms require and the physical condition will permit. The greatest precaution is to be used with regard to the local application of cold water or ice, as in some patients this may increase the cerebral hyperæmia. This is shown by increased headache and by the symptoms of compression becoming more obvious. It would seem that the hyperæmia of the cranium, in the disease under consideration, frequently remains confined to the region nearest the inflammatory focus, and cold applications to those parts heightens the pain by increasing the hyperæmia, while the effect of cold is beneficial when applied to remote regions of the head, as, for instance, the forehead. The promotion of the reflux of blood from the inflamed parts by the application of warmth, is, perhaps, most serviceable, since it is only thus that, with some patients, warm cataplasms applied to the region of the mastoid process and the corresponding half of the occiput, with or without the simultaneous use of cold to other parts of the head, cause such extraordinary relief. I have treated patients in whom at the same time ice was applied to the forehead and warm poultices in the vicinity of the diseased ear, in order to somewhat mitigate the raging pain. The revulsion from the head produced by other means will likewise be useful, especially at the beginning of the disease. In this respect the derivative action of the intestinal canal will prove most beneficial, the remedies being chosen according to the strength of the patient and the condition of the intestinal viscera; and it must also be remembered that only a powerful derivation can be of use. In those cases where the latter is not deemed necessary, care should be taken at least to keep the bowels in an open condition. As to internal medicaments, the principle should be adhered to, to avoid all such as would be injurious in concussion of the brain. With regard to purgatives, all those remedies should consequently by all means be avoided which will cause nausea and vomiting. The same principle likewise holds good in the case of patients who labor from idiosyncrasy with regard to some one medicine.

"By derivation by the skin by means of vesication or sinapisms, applied to the region of the mastoid process or to the nape of the neck, the inflammation in the deep-seated parts will not be lessened or even cut short, although it will greatly soothe the pain.

"In cases where these remedies are contraindicated, or are not sufficient to relieve the affection, it is advisable to employ, both externally and internally, those narcotics applicable to other inflammatory processes of the ear, but particularly when the rest of the patient at night is disturbed, and collapse threatened. As acute purulent otitis is a febrile disease, it is superfluous to remark that the strictest bodily and mental rest must be enjoined, and a restricted diet observed. The local treatment must further correspond to the objective symptoms presented in the ear at the time. The local treatment for a high degree of hyperæmia has been given. If the inflammation have passed into suppuration, the local treatment has the further object of giving an outlet to the pus, even by the formation of artificial canals, if it should be impossible to evacuate it in the natural way. Unless this is performed timely and adequately, the life of the patient will be exposed to the greatest danger from the proximity of the brain and its membranes in general, and of such important blood-vessels as the internal carotid, jugular vein, and meningeal veins. Should the Eustachian tube be narrowed or closed, or should it not suffice for giving a proper passage to the matter on account of its rapid formation, the artificial perforation of the tympanic membrane—*i.e.* the paracentesis of the membrana tympani, or myringotomy—is indicated. In such cases the phenomena presented by the membrana tympani will indicate the conditions of the organs in the interior ear. The artificial perforation of the tympanum has for its object not only to give an issue to the already formed pus, but also to cause relaxation of the engorged tissues by the division of the blood-vessels of the membrana tympani. Hence it is that, after the operation, the pain will quickly, and in a surprising manner, remit. Myringotomy is, therefore, an operation which causes the patient great relief and comfort, and may, under certain circumstances, be the means of saving life.

"As this operation is performed for two objects, it cannot be a matter of indifference what point for the incision we select. Since exudations will, according to the law of gravitation, always occupy the deepest portion of the cavity of the tympanum, the lower half of the membrane must be the most suitable. It is, however, advisable to give the preference to that segment which presents the greatest amount of swelling. As in the opening of any other abscess, so in that under consideration, the rule should be observed not to make the opening too small, since in that case the evacuation will be incomplete. It is better to make the incision a little too large than too small, since wounds of the membrana tympani, especially on the subsidence of the inflammation of the interior, will heal readily. The practical value of this latter principle is obvious in those cases in which the exudation into the cavity of the tympanum is very considerable, in which case the discharge cannot take place through too small an opening. Should the retraction of the tissue of the membrane following a large incision not produce a sufficiently large opening, it may even be necessary to make one of a crucial form.

"The operation of paracentesis is best performed by the myringotome, or with a simple cataract-needle. It may be done under direct illumination in those cases in which the meatus auditorius is wide enough to admit of sufficient light for the illumination of the deeper parts. If, on the contrary, it should be too narrow, the operation should be performed by means of the reflected light, and the reflector with the frontlet mirror should be used, thus allowing the surgeon the free use of both hands for the operation. The head of the patient is, at the same time, to be supported by an assistant, and the largest speculum introduced that the size of the meatus will allow. After the operator has made a proper inspection of the segment of the membrane to be incised, he inserts the myringotome at the most inferior point, and prolonging the incision upward as quickly as possible, in drawing the instrument out he cuts through the membrane to the proper length.

"The matter collected in the cavity of the tympanum will then be evacuated through the aperture. The bleeding from the separated blood-vessels is but very scant, amounting to but a few drops. It can, however, be increased by the careful injection of pure lukewarm water, sometimes practiced for washing out coagula. It is advisable to promote the discharge from the interior ear by the use of the air douche. As long as more pus is being formed at the original focus of inflammation than can be removed in the natural way, the aperture should be kept open by repeated applications of the air douche, and if this fail, by repeated inspection and the insertion of the probe. In case of closure of the opening, which may take place in one night, the repetition of the paracentesis is indicated. It has happened to myself and to other aural surgeons, that the operation had to be repeated twice, and even oftener, in the course of the same morbid process.

"To cause the matter to pass out by Valsalva's method is, in general, not advisable; a stagnation, although transient in the blood-vessels of the brain and its membranes, being produced by the pressure upon the veins, might exert a prejudicial influence. The patient, suffering under purulent otitis, even when an adult, is, however, generally too weak and languid to perform this movement.

"As long as the organs are engorged with blood, and painful, care should be taken not to drop astringent or other stimulating medicaments into the auditory meatus, or even make injection of such substances into the Eustachian tubes; but astringent gargles, and such as will promote absorption, are applicable in those cases in which an inflammatory swelling of the fauces complicates the disease under consideration. Even the application of a concentrated solution of nitrate of silver has proved beneficial, by diminishing the swelling of the mucous membrane of the Eustachian tube. Injections of astringents into the Eustachian tube ought to be employed with the greatest caution, and cannot be used before the pain is over, the fever ceased, the affection beginning to assume a chronic character, and there are those conditions generally indicating astringent injections. Employed under such circumstances, and with due regard to the rules given under the head of Catarrhal Inflammations, they may prove most beneficial.

"During the course of purulent otitis media, the necessary attention should also be paid to the several parts of the external passage of the ear. In this connection it must be mentioned that the perforation must always be kept open, to allow of the escape of the matter, which, if retained, might decompose, and exert a most injurious influence. If the opening has become contracted from a simple swelling of the soft parts, it should be dilated by the introduction of small pieces of lint, or similar substances. In not a few cases the application of leeches, or even incisions into the soft parts, will be indicated to subdue the swelling. If there should be a complication by inflammation of the external meatus, or periostitis in the region of the mastoid process, the latter is to be treated according to the principles laid down in the respective chapters.

"Should the ominous chills occur, the fever should be treated by larger doses of quinia, five or ten grains, repeated twice or thrice a day, the body of the patient being properly warmed during the chill, and acids given during apyrexia.

"When otitis depends upon a scrofulous or syphilitic diathesis, absorbent ointments are applicable during its course. In recent exudation their application in the region of the mastoid process is likewise most helpful.

"As in chronic catarrh with perforation of the membrana tympani, so in chronic purulent otitis there will be a most profuse otorrhœa. The effect of the remedies applied to the Eustachian tube must, in such cases, be supported by dropping appropriate medicaments into the external meatus. We make use most frequently of a solution of sulphate of zinc, from two to ten grains to the fluidounce of water, and of borax, alum, or tannin in the same proportion, and occasionally of sulphate of copper, from one to three grains to the fluidounce. Tannin is but seldom used. Where there is excessive swelling, a solution of nitrate of silver, from one to five grains to the fluidounce of distilled water, will not unfrequently be of the greatest service. Schwartze has of late recommended the caustic treatment of profuse otorrhœa, by means of a concentrated solution of nitrate of silver.

"Perforations of the membrana tympani, whether spontaneous or artificial, will generally heal of themselves, provided the inflammation has disappeared, and the loss of substance has not been too great, in the manner described under the head of Myringitis. The cicatrization must be watched in the same way as in the case of simple inflammation of the tympanum, and supported by adequate means.

PLASTIC INFLAMMATION OF THE MUCOUS MEMBRANE OF THE MIDDLE EAR (OTITIS MEDIA HYPERTROPHICA).

"This disease differs greatly from the other forms of inflammation of the mucous membrane of the middle ear, as well by the symptoms presented during its course as by its consequences, since its elements of form arising from the inflammatory process bear the germ of a higher organization; whereas those products resulting from catarrhal and purulent inflammation are rapidly given up to destruction. While in the latter the mucous membrane at best simply recovers its former properties, or, as in the purulent form, is more or less destroyed, and then supplied by cicatricial tissue, in this disease the affected organs are hypertrophied.

"From the dissolution of the newly-formed elements and the increase of the intercellular fluid in catarrhal and purulent inflammation, a more or less consistent mucus or purulent discharge will take place, which, respecting quantity generally, stands in a direct relation to its intensity. In the plastic inflammation, when occurring in its pure form, on the contrary, its fluid product consists only of increased intercellular fluid, with more or less cast off epithelial cells, and is usually but scanty, even in the severest cases. It is true that a more purulent product will occasionally occur upon the free surface, but in such cases the plastic inflammation has supervened on one of the other forms, to which the free product is owing. The disease under consideration occurs most frequently, attacking in its pure form a segment of the middle ear or its whole surface; or as is more often the case, joining from its beginning an already existing catarrhal or purulent inflammation, or the latter forms combining reversely with the plastic inflammation already existing. From the combination of these various forms, as a matter of course, many varieties of disease must arise, differing to a great extent from those of the pure form.

"A large number of those cases hitherto taken for simple chronic catarrh belong to this category. Hypertrophic otitis is owing to the same causes as the catarrhal and purulent forms. It is distinguished from them by the chronic course it generally runs. Its subjective symptoms are so inconsiderable, not only at its beginning, but after it has lasted for years, that the individual affected, and those about him, do not observe any sign of any existing disease of the ear. In other though rarer cases, on the contrary, it will be ushered in with intense and rapidly-developing objective symptoms (generally attacking more important segments), and the patient is tormented by most annoying, morbid, subjective symptoms. We shall know how to designate all these relations better after we have had an insight into the pathological processes that are going on.

"Owing to the injurious influences present, a considerable hyperæmia occurs in a segment or upon the whole of the mucous membrane of the middle ear. This is accompanied by extension, partly also by new formation of blood-vessels and increase of the intercellular fluid. The corpuscles of the connective tissue are increased by subdivision, and perhaps by other processes which cannot yet be stated with certainty. The result is a hypertrophy of the mucous membrane, corresponding to the degree of inflammation present. The epithelium being puffed up to some extent, diminishes somewhat the generally intense redness apparent in the mucous membrane after death. The tissue of the inflamed mucous membrane is generally less moist than in the catarrhal and purulent forms, and the exudation upon the free surface, arising from the protoplasm of the epithelial cells, is quite imperceptible. Sometimes the inflammation causes exuberant epithelial formations, which, undergoing further metamorphosis, constitute the basis of Cholesteatomes.*

"In the course of this process the newly-formed elements are either equally distributed over the whole inflamed surface or are scattered in groups. They develop themselves at these foci unequally; some will wholly or partly pass into higher organizations. From the division of their processes, which have numerous connections with the equally advanced processes of neighboring cells, a variously arranged, more or less intimately interwoven, soft, connective tissue will proceed.

"This, according to the preceding arrangement of the elements of form, will either be equally distributed over the entire originally inflamed part (resulting in equal hypertrophy of the mucous membrane), or in cases where the new formations occur at circumscribed foci, granular formations on the mucous membrane originate; or in those cases where the further development is going on in a form peculiar to them, they terminate in polypi. It is to be mentioned that, during the further progress of the newly-formed corpuscles, they are frequently not confined to the particular organs in which they originated, but growing, penetrate its epithelium, if there be any yet existing. If the latter should have been previously destroyed, they sprout out the more readily, tending toward a different surface from that on which they were produced. The same occurred, consecutive to inflammation, in the larger swellings (polypi) previously mentioned. It is particularly marked in the connective filaments and membranes, originated by the process, which so frequently occur here. Especially is this the case in the cavity of the tympanum and the cells of the mastoid process, where they grow from their original seat in the most eccentric directions, connecting with others corresponding in that manner. These effect an exceeding variety of anomalous connections of the organs of the inner ear. On the other hand, we cannot conceal that during the course of the process many of the newly-formed elements undergo retrograde metamorphosis. This consists in the separation into its molecules, passing into fat and being absorbed, or, as will sometimes happen during chronic processes, undergo calcareous degeneration. Even the newly-formed blood-vessels, as well as those simply extended, may waste during the course of the process. They are reduced to simple fibrous filaments, or they may, with their contents, be converted into fat or calcareous material, the entire molecular mass being gradually removed by absorption.

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* Tumors composed essentially of cholesterine and stearine.

"In this review we shall be enabled, *a priori*, on the one hand, to deduce all the possible symptoms, both subjective and objective; and on the other, to measure the danger to the hearing of the patient that grows out of this form of inflammation, especially at the height of the process. As has been mentioned before, the disease under consideration will be developed unperceived by the patient, unless it presents considerable intensity from its onset, or attacks particularly such segments as, for instance, the tympanum, which are so important for the conduction of sound, but especially those parts which close the round and oval openings into the cavity of the tympanum. Such processes can even cease again without ever having become known to the affected person, the discovery only being made by the post-mortem examination, showing hypertrophic spots on the mucous membrane, otherwise harmless pseudomembranes and slight obscurations on the tympanum. The case is different when the inflammation from the outset attacks the whole mucous membrane of the middle ear or important segment in considerable intensity. Then there will be no pain, but the patient will complain of difficulty of hearing, and perhaps some subjective noises in the ear. The latter phenomena may be due to causes similar to those of catarrhal and suppurative inflammation. The same is true of the sensation of oppression and fullness in the ear, which is usually combined with more or less pronounced giddiness and depression of mental activity. This disagreeable sensation is the more vexatious to the patient, as it continues longer than in the preceding forms of otitis, in which the moments of relief are more frequent in the course of the disease, the lesion being often mitigated by accidental occurrences. If there be no complication with another disease, and the inflammation under consideration makes the progress above described, the hearing, no less than the other morbid phenomena, will become worse and worse, as soon as the further development of new elements gives rise to such changes as will more and more impede the function of important parts. If the process last long, the severest disturbances of hearing will finally result from the secondary alterations taking place in the labyrinth, owing to the deficient activity of the auditory nerve. Complete deafness, for instance, can proceed from this simple inflammatory process, unless it be counteracted by all means possible; although, on the other hand, it is a fact that this termination is one of the greatest infrequency, the hearing of the [illegible] ear being decidedly interfered with after [illegible] process in but [illegible] minority of [illegible] of [illegible] there rem[illegible] simply [illegible] gree.

"Th[illegible] phenomena [illegible] so[illegible] when the hype[illegible] compared with [illegible] the complication with [illegible] the subjective phenomena [illegible] will become most mark[illegible] decidedly alter its clinical appearances. The objective symptoms to be noticed in plastic otitis vary with the attacked part, the intensity of the process or complication with other forms, and, as a matter of course, the previous condition of the affected ear. The Eustachian tube is generally affected sympathetically from its onset. Its orifice, consequently, must thereby become closed or obliterated, and the changes in the tympanum and the ossicles, above described, consecutively take place, according to the quality of the mucous membrane of the cavity of the tympanum, and the various other affections of the tympanum itself. Upon the inspection of the external passage of the ear, different alterations will become observable, which need no further explanation, as they are the result of similar physical lesions to those in the preceding chapters on inflammation of the middle ear. Nor do the results of auscultation upon a single examination offer reliable points. They inform us, at best, about the relations of space in the inner ear. It is not till auscultation has been performed repeatedly and at different periods that we obtain information, in so far as the copious exudation occurring in other forms of inflammation, the symptoms discovered, together with the ocular examination, will vary from those of the hypertrophic inflammation. In this form of inflammation the diagnosis cannot, from its commencement, always be made with that certainty which would be desirable for the physician; only after a longer observation of the patient, or the duration of the disease, can it be obained with certainty. All the symptoms presented will tend o increase of bulk, provided the inflammation occurs in its usual form, or to hypertrophy accompanied with other sympoms. When plastic otitis occurs in its usual form, and especially when the mucous membrane on the interior wall of he cavity of the tympanum is affected, the prognosis is in general unfavorable. With regard to the future capacity of hearing, sometimes only at its outset can the increasing hypertrophy be checked, or at best, its bad consequences be essened by a continued careful treatment. It must, however, be remembered that hypertrophic otitis may run its course without causing any striking difficulty of hearing, when those organs have remained intact, being of greater importance for the conduction of sound. As a matter of course, the prognosis will differ when there are complications with other morbid processes. The treatment should be to check the morbid process powerfully, and, at the same time, palliate the bad consequences of the deafness resulting from the hypertrophy. In the former we must endeavor to arrest the further development of the newly-formed elements of inflammation. If the mucous membrane of the Eustachian tube is principally affected, we should endeavor to keep it open by the application of the air douche, and the insertion of laminaria, or other bougies, as well as to promote absorption by compression, already exercised by the application of the bougie, and so forth. In cases of less violence, perhaps diffused over the mucous membrane of the cavity of the tympanum, injections of a solution of caustic potassa, gr. ½ to gr. i to f℥i of distilled water, once a day, or repeated at longer intervals, will be most serviceable, the epithelium being softened by them, and caused to be sooner cast off, after which the air douche must be employed for the evacuation of the free products. Dilute acetic acid, used in a similar mode to the caustic potassa, will be of great service. Acetic or iodic ether, or ammonia vapor, and in syphilitic cases, weak solutions of corrosive sublimate, gr. ½ to gr. i to f℥i of water, have likewise given satisfactory results. In cases of greater intensity, the bulk of the mucous membrane being considerably increased from the onset of the morbid process, a more or less concentrated solution of nitrate of silver, grs. i to v to water f℥i, is indicated. This solution, as well as the preceding medicaments, are to be injected by the Eustachian tube, especially by the spray apparatus of Weber, which is most suitable for this purpose. Catheterization of the Eustachian tube is performed by means of a common tube catheter passed into the cavity of the tympanum, and the spray injected by its bulb."

CHAPTER XII.

OTITIS MEDIA AND INTERNA INVOLVING MASTOID PROCESS AND CELLS—SQUAMOUS PORTION OF TEMPORAL BONE—CEREBRUM AND CEREBELLUM.

THE mastoid process in children before the first year is not developed, and merely consists of the horizontal portion, which is so intimately connected with the *cerebrum* that this portion of the brain is primarly affected. When, however, the child becomes the boy or girl, the *cerebellum* is the part usually involved. The most frequent cause of disease of the mastoid cells in childhood is *cold* contracted immediately after birth, followed by a discharge which, if it had been noticed, was preceded by a painful cry of the infant, or, for twenty-four hours, by a languid, drowsy state, accompanied with more or less fever, and, in some instances, brain irritation, which the child never recovers from. As the disease progresses, the tympanum or middle ear becomes filled with mucous or muco-purulent matter, which causes ulceration of the membrana tympani, and it gives way, with relief to the symptoms, and the discharge escapes, and continues for months and even years, to the detriment of the health of the child, or it *may* be cured by proper treatment. In other cases the peculiar form of the mastoid cells preventing the escape of the matter, it is retained, and causes pyæmia, and even death. In older children and in adults the primary causes are scarlet fever, measles, smallpox, scrofulous, and tubercular disease; the secondary cause in almost every case being a *catarrh*, by its direct influence upon the ear with its broken membrane, or through the nose, pharynx, or Eustachian tube, leading to the middle ear, thence by the lateral sinus into the circulation, the cerebellum, or its membranes.

The writer will report a number of cases, most of them from his private practice, and watched carefully at their homes, with the diagnosis and successful treatment by operative procedure:

Case I. *Disease of the mastoid process; no discharge from external meatus; recovery.*—Martin F., aged seven years, a large and robust boy, but of a tuberculous family (father and four uncles having died of phthisis), was convalescent from scarlet fever, and was discharged well on March 15th, 1858. Was called in haste to see the boy on the 27th. There was great pain and swelling behind the ear, over the mastoid process, but no discharge from the external meatus. He was freely leeched, and purgatives administered, followed by anodynes to relieve the pain. On the 28th, the swelling was on the increase, and extended to the face and eyes, with fever and symptoms of convulsions. It was then proposed to cut down to the bone dividing the periosteum, as the only means of relief, to which the mother consented. An incision was made about an inch long behind the ear, and as nearly as possible parallel with the concha; as the ear at this time was almost horizontal, a profuse gush of blood followed, mixed with imperfectly-formed pus; the wound bled for three days. The pain was much relieved, and, by the use of saline mixture with sulphate of morphia, he was able to sleep, which he had not done since the 27th. A poultice was applied on the third night, and by the fourth, pus flowed freely, which was encouraged; and by the end of the sixth week the wound was disposed to close; this was prevented by a blister. The discharge continued for four weeks longer, when the wound was allowed to close, the roughness of the bone having disappeared.

Report January, 1871. The young man is now twenty years of age, and has enjoyed good health since, being able to be out in all weather; is bright and intelligent, and is at work in a cotton-mill; his hearing in the left ear impaired; right, very good. Over the mastoid cells there is a depression of a bluish color, from loss of bone. Has never had a severe attack since, excepting now and then a slight discharge from one (deaf) ear, and he is an expert mechanic. Has since lost his mother by phthisis.

In the same neighborhood the writer examined a boy, James R., aged five years, in 1862, who had a similar swelling after an attack of scarlet fever; it opened of itself after long poulticing, and continued to discharge from the back of the ear for twelve months; it then ceased, leaving a deep depression behind the ear with loss of hearing; the boy is imbecile and cannot articulate.

CASE II. *Disease of the mastoid process; perforation of the membrana tympani; recovery.*—Mrs. A., aged thirty-five years, whose case was of the same character as the one just reported, was treated in a similar manner with equally good results.

CASES III., IV. *Abscesses over the mastoid process in mother and child; similarly treated, and both recovered.*—March 25th, 1869, Thomas N., aged five years, applied at Howard Hospital with an abscess over the mastoid process. He is convalescent from an attack of measles. The swelling back of the ear commenced three weeks previously, then subsided, and again began to swell. On examination, there was swelling, redness, and feeble fluctuation. There was no discharge from the ear. On informing the mother what was to be done, she replied, "Well, do what you think is right, as you performed the same operation on my ear when this child was only ten months old. I was at that time three months under your care, and was cured, and remain so." The writer examined the back of her ear and found a deep depression, where there had been a loss of bone. Her hearing in that ear was not perfect, but she was not *very* deaf. The operation was then performed on the boy, when, by the aid of the probe, the bone was found to be denuded of its periosteum. Being of a strumous habit, he was ordered syrup of the iodide of iron, a small poultice of ground flaxseed, and subsequently an ointment of the red oxide of mercury, to dress the part and keep it open.

April 1st. The wound had suppurated freely, but the opening was disposed to close; it was accordingly enlarged, and the previous treatment continued, with good diet and exercise in the open air. By the end of the month he reported himself well, wound healed, and all swelling disappeared. Many other cases of this same class the author has seen while attending his clinic during the last seventeen years.

CASE V. *Perforation of the mastoid process; otorrhœa; removal of necrosed bone; recovery.*—Mary R., aged eight years, a robust-looking child, came under my care early in September, 1861, at the Howard Hospital. It was reported that she had suffered from scarlet fever of a most malignant type, having been in a state of coma for several days. This gradually passed away, when the throat and ears became affected, and a long period elapsed before complete convalescence took place.

Present condition.—She is deaf in the right ear, with a constant discharge of offensive pus, etc.; on washing out the parts, the meatus was found to have a white, soft deposit on its surface, with a granular condition near the membrana tympani, with a perforation of three-fourths its size.

A mild wash to be applied of nitrate of silver in solution. The parts kept clean by repeated injections of tepid water. Counter-irritation was to be kept up in front of the ear, and air was to be passed through to keep the Eustachian tube open and force any accumulation of pus out from the middle ear. A guarded prognosis was given as to the ultimate result. Having improved considerably, she ceased her attendance, and the writer saw nothing of her until called in haste to see her on September 21st. The history received from her father, an intelligent man, was as follows: The Sunday previous being a very hot day, the child was sleeping on a sofa, when the father, to cool the house, opened both the front and back doors, which produced a strong draught of cool air upon the sleeping child. After retiring, she was attacked in the middle of the night with intense pain in her ear, causing her to scream and preventing all sleep. The parents applied a blister and used other means, but the relief was of short duration. When the writer was called to her she was suffering intense pain; fever, with alternating chill; pulse, one hundred and thirty; there was swelling over the mastoid region, involving the side of the face and eye.

Treatment.—Believing that pus was formed in the mastoid cells and was endeavoring to make its way outward, requiring only an outlet, the writer divided the skin freely, muscle and pericranium, down to the bone. On withdrawing his knife, blood flowed very freely, mixed with imperfectly-formed pus. A poultice was ordered, to be repeated every few hours. A saline mixture of citrate of potassa, containing sulphate of morphia, was directed, to relieve pain.

September 22d, 23d, 24th–30th. Better. Discharging pus from the opening, which being not quite free enough, applied powdered red oxide of mercury to increase the discharge.

November. During this month, visited the case every few days. The opening being disposed to close, introduced a sharp hollow steel probe, so as to perforate the surface of the bone, and applied to it freely the solid nitrate of silver, which increased the discharge.

December. In the early part of this month, the opening was again enlarged, and a piece of bone discharged. On the 19th, a larger piece of carious bone was found by the probe to be movable, and by enlarging the wound, it was removed with some difficulty, the bleeding being very free. A few days after this operation the discharge ceased, and the wound healed. There is a deep depression behind the ear from loss of bone. The membrana tympani has closed somewhat; the child is deaf in that ear, but otherwise well, and continued so for several years. The bone measures six-tenths of an inch in length and three-tenths of an inch in width. It is now in the writer's collection, and has been examined by numerous distinguished surgeons.

In the cases above related, which might have been increased by many others, we have examples of three of the principal forms of ear disease in the mastoid region, which will frequently be met with by any one who devotes much attention to the ear, and occasionally by those who pay but little attention to this department. The writer trusts they will be found useful as guides to diagnosis and treatment.

In the first case, the simple division of the periosteum, with the subsequent application of the blister, was all that was necessary to complete the cure.

In the second case, it required the second enlargement of the opening and breaking down of the bone by the application of nitrate of silver.

The third class of cases was of greater danger to the patient, and it involved a larger number of the cells of the mastoid process. It therefore required a free perforation of the bone, and its removal in a diseased state.

This was the first operation (December, 1861, and published February, 1862) of the kind that had been performed in the United States (so far as the writer is aware), and he has repeated the operation several times since, as, in a case the result of a severe fall, foreign body in the Eustachian tube, etc. It had been performed only eight times in Europe to the above date (and from 1862 to 1871), by Schwartze, Pagenstecher, Hinton (London), Jacoby, Agnew, and Roosa, of New York.* "Köppe† and Schwartze report a case of epilepsy caused by retained pus in the middle ear, which was relieved by perforation of the mastoid." In 1871, by Dr. F. Buszard‡ (London). Two successful cases are reported in the London *Lancet* for April 29, 1871, of abscesses in the mastoid process, with perforation of the bone, under the care of Mr. Barwell, of Charing Cross Hospital.

CASE I.—E. F. was only six years of age. History: severe pain in the head, which had the effect of sometimes driving her "half mad," and at other times of producing stupefaction. Two operations were necessary, the second by a probe, and the T-shaped incision was maintained open by a nail-shaped plug of gentian root until the thirty-sixth day after the first operation.

The second case was of greater interest, on account of the patient having reached the comparative mature age of forty-seven, and as the premonitory symptoms were accompanied by profuse epistaxis.

Now it is the recognized operation in properly-selected cases. It was, perhaps, too frequently and indiscriminately performed at first, and afterwards entirely rejected, and considered illegitimate, although there can be no doubt that cases occur in practice (such as the writer has given) in which the operation ought to be performed in obedience to the fundamental principle that every accumulation of pus in the tissues, especially when in contact with bone, is to be evacuated as soon and as completely as possible, in order to prevent the noxious effects upon neighboring parts and a further spreading of the inflammation.

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* The Mastoid Process in Inflammatory Affections of the Middle Ear, by D. B. St. John Roosa, M.D., Medical Record, Dec. 1st, 1870.

† Archiv für Ohrenheilkunde, Bd. v. p. 282; Roosa, op. cit.

‡ British Medical Journal, January 28th, 1871, p. 88, and Medical Times, Philadelphia, April 15th, 1871.

The tissues adjoining the mastoid process, viz., the dura mater, the internal carotid artery, and internal jugular vein, with the transverse and lateral sinus, are so important, that a morbid process which spreads to them from the middle ear is fraught with danger to life, independently of the circumstance that the sense of hearing may be weakened, or even entirely annihilated. The cells of the mastoid process are in open communication with the cavity of the tympanum; they are covered with the same mucous membrane, and participate in all the affections of that cavity. Pus accumulates the more readily in these cells, as their communication among each other, and with the anterior part of the middle ear, is often very narrow, so that the pus is easily shut in; besides which, a large portion of the mastoid process lies deeper than the membrana tympani and the meatus auditorious. The membrana tympani may, therefore, be perforated, and the secretion of the cavity of the tympanum be allowed to escape freely outward; yet this will not provide an outlet for the pus within the mastoid process, as has been shown in a case before related. If the matter accumulated there does not spontaneously make its way outside by the formation of a fistula behind the ear, which sometimes occurs, the surgeon has no choice but to break through the external layer of bone, in order to gain access to the seat of the pus. The introduction of warm vapors into the Eustachian tube has no decided beneficial effect in severe cases, although, in mild forms of this affection, frequent gargling and repeated blowing of air into the tube, by means of a catheter, or an attachment to Politzer's bag, may serve to prevent the case from getting worse, and may act favorably altogether. If the bony layer which has to be perforated be very thin and fragile, an ordinary buttoned probe will answer the purpose (or a hollow steel director or probe); but if such be not the case, a hollow chisel ought to be used, and, in every instance, an incision, about an inch long, behind the ear, and parallel with the concha, ought to precede the perforation of the bone, as first recommended by Dr. Wilde, of Dublin.* This incision should be made, even when "an indistinct sense of fluctuation can be discovered, at least an inch long in the periosteum (and this alone will sometimes be all that is necessary). It is generally required parallel with, and about three-quarters of an inch from, the attachment of the auricle, in order to avoid the posterior aural artery, which, when divided, bleeds profusely. The knife should be drawn from below upward, and, from the swollen state of the parts, the depth to which we are obliged to introduce the instrument is often nearly an inch. The hemorrhage, unless we wish to extract blood, may be arrested by placing a dossil of lint within the incision," saturated with the following styptic of Prof. Pancoast:

℞.—Saponis (Castile), ʒi;
Potassæ Carb. ʒij;
Spts. Vin. Rect. f℥iij. M.

If further relief be required, the chisel, director, or hollow probe should then be inserted in the middle of the incision, at an equal height with the opening of the ear, and ought to be carried horizontally, and a little forward In this way the dura mater and transverse sinus are avoided, and the surgeon rapidly arrives in the large cells which are close above and behind the cavity of the tympanum. The instrument must, of course, be used very gently, and with interruptions in some cases for a considerable time, so as to avoid a sudden piercing of the bone.

The first proposal to perform this operation was made by Johannes Riolanus (1649) and Rollfuik (1656), who recommended it for deafness and noises in the ear, caused by obstruction of the Eustachian tube. Valsalva, in 1704, made injections through a fistulous opening which existed behind the ear; and J. L. Petit was the first to perform perforation of the mastoid process by means of a hollow chisel and hammer. The life of the patient was saved thereby. Dr. Von Tröltsch,* the distinguished author and Professor of Aural Surgery of the University of Wurzburg, Bavaria, reports eight cases, all of which terminated successfully; so that the operation, if properly and carefully performed on selected cases, is not a dangerous one.

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* The Nature and Treatment of Diseases of the Ear, p. 233, Am. ed., Phila., 1853.

The second case occurred in the practice of Jesser (1776); his patient was a soldier, who had for several years suffered from pain in the ear, with suppuration and deafness. A slight prominence having been formed behind the ear, Jesser made an incision one inch long, after which very little pus came away, and it was only when he had penetrated with the probe into the cells of the mastoid process that much pus was evacuated. The pain in the ear then ceased at once, and never returned, and the hearing was also improved. The mastoid process, on the other side, was also pierced in this patient, with a trocar, for deafness, not for pain, and the hearing improved. The operation was now called "Jesser's operation."

The third case is that of Fielitz. A young girl lost her hearing on one side, in consequence of an acute disease, and suffered for five years, at intervals, from an offensive discharge from the ear, which was always preceded by fever and severe pain in the ear. The mastoid process was pierced with a pointed instrument, and injections were made, after which much pus escaped. The discharge gradually ceased, and the hearing became completely re-established.

The fourth case is that of a patient under the care of Weber (1824). A peasant had suffered for three months from a very painful suppurative otitis, and as an incision behind the ear did not mitigate the pain, a trocar was thrust, three lines deep, and obliquely forward, into the highest prominence of the mastoid process, ten lines behind the ear, seventeen lines from the upper, and four lines from the posterior, edge of the mastoid process. Much pus came away, and the pain disappeared immediately; the suppuration ceased four weeks afterwards, and a complete cure was the result.

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* Medical Times and Gazette, Sept. 26th, 1861 (London).

The fifth case is that of Forget (1849). A young man became affected with otitis in consequence of a cold; copious suppuration in the ear set in, accompanied by paralysis of the facial nerve, but the latter disappeared a year afterwards. Two years after the commencement of the illness, the patient became completely deaf on this side, and the neighborhood of the ear was greatly tumefied. The mastoid process was then pierced by means of a hollow chisel, and much pus escaped. A month afterwards, a sequestered bone, three centimetres high and two centimetres thick, was removed, and from that time the patient began to improve, the suppuration ceased, and the hearing returned.

The sixth and seventh cases occurred in the practice of M. Follin, of Paris (1859). In both cases there was a fistulous opening, which was dilated by that surgeon by means of the trephine; six weeks after, the cure was complete.

The eighth case is one of Dr. Von Tröltsch (1860). A girl, aged ten years, complained, the second day after the eruption of scarlet fever, of violent pain in both ears, which continued to increase until the fifth day, and then began to diminish, in consequence of a discharge from both ears having commenced. The fever took its regular course. The discharge from the ears continued, and after some time the pain became again severe, especially behind the right ear, where a slight swelling was also seen. Three weeks after the commencement of the illness the pain became most intense, and was accompanied with headache and deafness. Pressure on the mastoid process augmented the pain; the skin on the right side was slightly reddened, and the whole neighborhood behind the ear and the upper and lateral region of the neck were diffusely swollen. Both meatuses were filled with thin pus, after the removal of which their walls appeared to be tumefied, and, in the background, a drop of water was pulsating, an evident sign that both membranæ tympani were perforated. Injections of lukewarm water were then made four times a day, and after the injection, a weak solution of acetate of lead (five drops to the ounce) was dropped in, while mercurial ointment was rubbed in and around, and chiefly behind the ear. During the next few days the discharge was not lessened, and the pain very much increased; the swelling behind the ear became more considerable, was very painful on pressure, and felt œdematous; no fluctuation was perceived.

Six days afterwards, an incision from one and a half to two inches in length was made behind the insertion of the concha, and parallel with it down to the bone. The bleeding was profuse, and pus appeared immediately afterwards in the level of the external opening of the ear. In the evening after the operation, violent pain was felt in the wound, but no longer in the ear; there was no fever. The swelling behind the ear became less on the following day, but again increased on the second day, when the pain also became more violent and the discharge less abundant; on pressure behind the ear, pus escaped from the meatus. Two days afterwards, Dr. Von Tröltsch tried to penetrate the incised wound, which had already become narrowed, by means of a buttoned probe. In this he succeeded only for three lines, and he therefore continued perforating with the probe, and afterwards placed a piece of charpie as deep as possible in the opening. Soon after, much pus, at first thin and afterwards thick, escaped from the opening, while only a trifling quantity was discharged from the meatus. On the following day the patient felt better; the pain had entirely disappeared, and the hearing was improved. Injections were now made daily; the probe could penetrate an inch deep, and the injected water escaped through the meatus. About two months after, all discharge had ceased and the recovery was complete. The girl died eighteen months afterwards, of tuberculosis of the lungs. The post-mortem examination showed the following condition of the organ of hearing:—On the right mastoid process a cicatrix was seen, which corresponded to the incision, and from this proceeded a canal in the mastoid process, with smooth walls, in the form of a cone, with its base behind, passing from behind forward, four millimetres long, and closed inside. The external meatus was not pathologically changed. The mucous membrane of the tube was pale and covered with a little mucus; the narrowest part of the tube was abnormally dilated; its osseous part was cylindrical and also dilated. The posterior half of the membrana tympani was wanting, except a small strip behind and above. The anterior part of the hole was drawn inward, and grown together with the opposite wall of the cavity of the tympanum. The manubrium mallei was drawn inward, and firmly soldered to the wall of the labyrinth. The cavity of the tympanum, therefore, consisted, properly speaking, of two parts, the anterior of which, lying before the manubrium, was connected with the tube, and the posterior, with the meatus. There was no communication between these two parts, so that water injected through the meatus did not penetrate into the tube. The posterior half of the cavity of the tympanum, which communicated with the meatus, was also completely closed, posteriorly and anteriorly, towards the mastoid process. The stapes was grown together with the upper part of the perforation, but it was movable, and its joint with the crus of the incus was not severed. The malleus and incus were also movable. Between the head of the malleus and the ostium tympanicum of the tube, there was a firm and strong band, horizontally situated, which contained the tendon of the tensor-tympani muscle. This band connected the inner and the outer wall of the cavity of the tympanicum, and communicated with the exudations separating the cavity of the tympanum in two halves. At the left side the meatus did not contain any abnormal secretion. The upper part of the tube was abnormally dilated. The posterior half of the membrana tympani, close to the manubrium of the malleus, showed an indented perforation of the size of a grain of hemp, the posterior edge of which was grown together with the opposite wall of the cavity of the tympanum, and with the capitulum of the stapes.

A series of rather succulent adhesions connected the upper and anterior part of the membrana tympani with the tendon of the tensor tympani muscle and the opposite wall of the labyrinth. A thin but firm adhesion was seen backward. The mucous membrane of the cavity of the tympanum was thicker, softer, and contained more blood than usual. All the ossicles were freely movable. The cells of the mastoid process were fine, its meshes filled with a reddish-yellow liquid, which only contained a few small nucleated cells and exudation corpuscles. The history of this case gives another striking proof of the fact that very considerable changes may take place in the membrana tympani, and, nevertheless, the hearing of the individual concerned may not be seriously affected.

CASE I. *Of otitis media and interna, followed by death, with a partial post-mortem examination.*—Mary H., aged six years; had scarlet fever when three years of age; was feeble a long time, but her ear was not treated except to keep it clean by washing. About May, 1857, the child began to complain very much, and came to my office. Ordered a small blister, and a solution of one grain of sulphate of zinc to the ounce of water as a wash. Internally, as a tonic, half a grain of sulphate of quinia three times a day. On examination, the right membrana tympani was found to be entirely gone, and there was considerable discharge of unhealthy pus from the ear, indicating caries, or disease of the bones. Having been benefited by the treatment, she did not return to my office until June 6th, when she was suffering intense pain from inflammation of the middle ear, the result of exposure, the discharge being much increased. Being a very willful child, her parents had but little control over her. I directed counter-irritation to be renewed, with the internal use of an opiate to relieve the pain; did not use leeches on account of her feeble condition.

Visited her on the 8th. Pain still very persistent, and head bent to the side of the affected ear. Fearing convulsions, I ordered four leeches to the back of the ear, over the mastoid process, with sedatives internally, opiate fomentations to the ear, with warm foot-baths. In spite of treatment she continued to grow worse, and had considerable discharge of pus from the nose, and was unable to swallow for a day or two prior to June 26th, when she had a severe attack of convulsions. This was counteracted by the employment of leeches and cold applications, but was soon followed by a state of coma, and she died on the 28th of June. The family being unwilling to allow an examination, the writer was only permitted to remove the temporal bone and ear, which he did by sawing a V-shaped piece, and removing the entire ear. In spite of her anæmic condition, the coverings of the brain were much congested and thickened, with effusion of fluid into the ventricles, and considerable softening of the substance of the cerebellum.

Ear.—The membrana tympani was almost gone, yet, strange to state, in the middle ear, although filled up with greenish pus, and the membrane soft and detached, was found the malleus and incus, which was retained. On cleaning these bones, however, they were found to be ulcerated. The semicircular canals and the cochlea were almost free from disease, which had passed from the middle ear to the lateral sinus and membranes of the brain, causing a low form of inflammation, with softening and effusion, ending in convulsion and death.

What seemed very remarkable in this case was the long period that the small bones remained in the ear, notwithstanding the discharge, showing how slowly the ligaments connecting the bones ulcerate.

CASE II. *Case of chronic otitis interna with acute attack extending to the brain, followed by death; with post-mortem examination, etc.*—Mary E. C., aged fifteen years and eight months, about the year 1866 suffered from an acute attack of otitis externa from cold, involving the membrana tympani. She applied as a patient under the writer's care at Howard Hospital. She was treated by the application of tincture of iodine over the mastoid process, with active purgatives. When the acute symptoms disappeared, the cleansing wash of warm water was changed to a mild astringent one, and she was put on the internal use of the syrup of the iodide of iron. After a few visits she ceased her attendance. She applied at the hospital again on the 14th of December, 1868, with an acute attack of otitis media and interna; the pain was over the occipital region. The history given by her mother, an intelligent but feeble woman, was as follows: That the girl had recovered from her former attack with some loss of hearing, with now and then some pain and slight discharge from the ear. She was, however, affected at times with a distressing feeling of giddiness, and had to give up part of her occupation of pressing goods, requiring stooping; and at times this feeling was so strong that she was sure, had she not taken hold of some object to support herself, she would have fallen.

At the age of *fourteen* she began to menstruate, and always after the flow came very freely, even more in quantity than her mother at her age; this, however, brought no relief to the symptoms of giddiness, and yet she was bright, cheerful, and her general health seemed otherwise good until her attack.

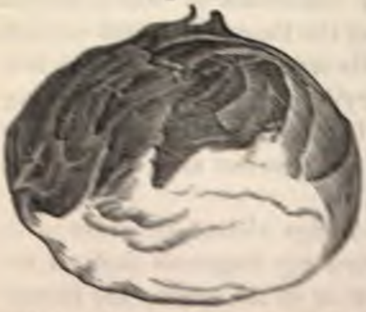
As the external meatus was full of pus and mucus, she was directed to have warm water to wash the parts, with solution argenti nitratis, applied to diminish the discharge, and leeches at the lower part of the auricle, with foot-baths and anodynes to relieve pain and procure sleep. After the acute symptoms had disappeared, blisters dressed with morphia were freely employed; and, to affect the brain symptoms, large doses of bromide and iodide of potassium. Most of these remedies were rejected by the stomach, as there was constant violent vomiting, against which numerous agents were employed, none of them procuring much relief except small pieces of ice. There was a tendency to constipation, which was relieved chiefly by injections of warm water. The chief point of pain was from the top of the spinal column to the occipital bone. Her pupils were generally contracted, with defective vision; pulse varying from 70 to 90. During the last two weeks the eyes became injected, and unless under the influence of atropia, she was not able to see at all distinctly.

January 26, Prof. James A. Meigs visited the case with me in consultation, and confirmed my diagnosis that an abscess or abscesses had formed on or in the brain. He recommended the use of morphia to relieve pain, and to continue the use of the bromide of potassium and blistering. The ear still continued to discharge pus and mucus, and only once blood, and a small piece of bone, which was lost before there was an opportunity of seeing it. Her head was kept on a pillow, bent forward on her chest, and if it was moved it gave her great pain; and in one instance, when moved to change an under-garment, it produced such a severe convulsive movement that it was thought she was dead. There was slight internal strabismus, with a tendency in the tongue to be protruded to the left side. She discharged a considerable amount of mucus, etc. by the mouth and nose, but never had a cough or pain in the chest. She swallowed without difficulty; could move her arms and limbs; her tongue was moist until two days before her death, when it became almost black. She died February 15th, 1869, without a struggle, singing a few hours before she passed away. She was deaf in the left ear, with perforation of the membrana tympani, except after a free discharge of pus or blood.

Post-mortem forty-eight hours after death, assisted by Drs. James Collins, J. S. Cohen, and C. S. Turnbull.

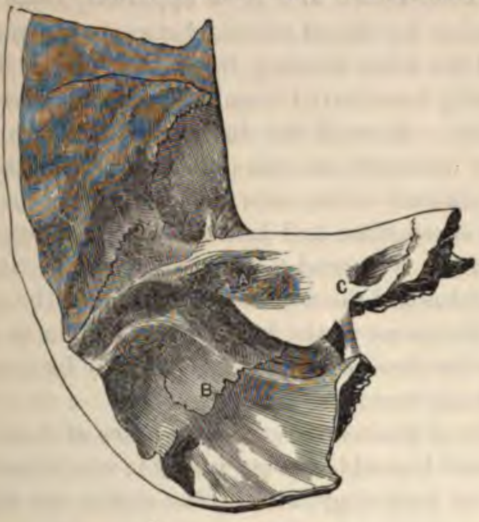
The incision was made through skin, fascia, and muscles down to the bone on a line with the ear, and the scalp dissected back to the occiput, and forward, so as to expose the temporal bone, cutting close to the bone and zygomatic process; the cranium was sawn through posterior to the coronal suture, so as to prevent deformity. A second incision was made just above the temporal bone back to the occipital bone, and then the temporal bone sawn down to the base, and by means of the chisel the bone was separated so as to obtain the bony portion of the ear entire to examine it. The brain was then removed, cutting carefully into its membranes, which were slightly congested; veins very turgid; surface of brain congested; effusion in ventricle, containing three ounces of serum, and vessels much distended, but no abscess in brain or on its sur-

Fig. 60.



face; slight effusion in sheath of optic nerve. The cerebellum was then removed; it was softened, and the left lobe, situated at B (Fig. 61), when cut into, was found to contain a sac (Fig. 60) of pyogenic membrane containing about two ounces of green pus, which did not separate when allowed to stand. When examined by the microscope there was seen true pus globules. There was thickening of the membranes at this point, and a necrosis of the bone opposite it into the middle ear, as seen in the drawing (Fig. 61).

Fig. 61 —Examination of the Bone removed.



The temporal bone was deficient in size, slightly necrosed, with a small opening at A, through the sinus into the cerebellum on the one side, and into the middle ear on the other. This sinus was filled with dark-colored coagula.

The lining of the whole of the external meatus was soft, elevated, and of a dark color; its surface was denuded of lining membrane beneath its purulent matter. There was but a small rim of membrana tympani, and a part of one of the small bones. Upon filing the bone down to the semicircular canals, it was found that they were also filled with this pus, etc. By making a section with a very delicate saw through the horizontal portion of these cavities, the vestibule and cochlea were exposed. A portion of the membranous labyrinth was removed and examined, and it was found to contain pus globules. The nerve, as it passed from the external ear to the brain, the portio dura (C), was healthy, but the portio mollis of the seventh pair, the auditory proper, was diseased.

A portion of the brain, under the microscope, was normal in structure, but the cerebellum had lost its beautiful arbor vitæ-like character, its fibres being broken and softened.

This class of ear cases, according to Toynbee, are remarkable and rare, for there is evidence to prove that the disease originated elsewhere; and it is apparent, from the direct communication by blood-vessels between the membranous meatus and the bone forming the lateral sinus, that disease could be easily transferred from the inflamed meatus to the bone beneath. Most of the instances which we have seen, and are also recorded, are cases advancing from the tympanic cavity, or mastoid cells, outward to the meatus, in which process the cerebellum and lateral sinus were implicated.

This affection is termed by Toynbee chronic catarrh of the dermoid meatus and the mucous membrane of the tympanum. We prefer the name at the head of this article, as our dissection proves the disease of the bone, as may be seen by looking at the bone removed.

In a series of dissections of fifteen cases of fatal otorrhœa, Von Tröltsch* has added some valuable contributions to our knowledge of pathology, and of the course by which these cases become fatal. An abstract of seven of the cases is here given.

In a case of purulent inflammation of one year's duration with polypus, caries of the labyrinth wall of the tympanic cavity had resulted in a fistulous communication through that wall just above the fenestra ovalis, through which the purulent matter had passed into the vestibule and semicircular canals, thence through the internal cribriform plate along the meatus internus to the brain, causing a fatal meningitis of the base of the brain.

In another case a polypus from the mucous membrane of the small cavity, a part of the tympanum above the deeper portions of the external meatus, had projected through the bone into the meatus, so that it could easily have been mistaken for a polypus of the meatus.

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* Archiv für Ohrenheilkunde, Bd. iv. Heft ii., 1869.

A third case offers the peculiarity of multiple unconnected abscesses in the brain, one on the side of the diseased ear, and one on the opposite side; the lateral ventricle on that side being also filled with purulent matter.

In the sixth case a purulent inflammation of right tympanum, *without a perforation of membrana tympani*, led to a perforation of the roof of the tympanic cavity, phlebitis of the vena mastoidea and transverse sinus with metastasis in the lungs. The membrana tympani was found much thickened, and had thus résisted rupture.

In the seventh case a purulent inflammation of middle ear had destroyed the stapes with the membrane of the fenestra ovalis, and through the vestibule caused a pachymeningitis with two abscesses in brain and a phlebitis of the superior petrosal sinus. The phlebitis of this small sinus is explained by the small blood-vessel, which runs inward towards the mastoid process under the superior semicircular canal, entering the bone on the inner surface of the petrous portion, above and between the orifices of the meatus internus and the aqueductus vestibuli. This vessel was first described by Odenius,* and in two cases he was able to follow it into the superior petrosal sinus, so that we have here the circulation of the middle ear in new direct communication with this sinus.

The following Case III. is of periostitis of the mastoid portion terminating in caries and death, as may be seen in Figs. 62 and 63, taken from a post-mortem specimen in the author's cabinet.

The caries advanced internally, involving the fibrous and osseus portion of the temporal bone, and terminated fatally in abscess of the brain. In such cases, when we cannot see the swelling, and the discharge is from the meatus, of a thick yellow pus, alternating with a thin and watery fluid, and there has been a sudden exposure, followed by intense headache, obstinate constipation, pain in the back of the ear, chill with delirium, our suspicions ought to be aroused. The dura mater is either inflamed or very much irritated; and active measures should be taken to arrest the progress of the mischief by bleeding, active purgation, and revulsives to the feet, in blisters to the mastoid process, etc.

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* Medicinsk. Archiv, Bd. iii. No. 4.

Fig. 62.—Anterior View of Temporal Bone.

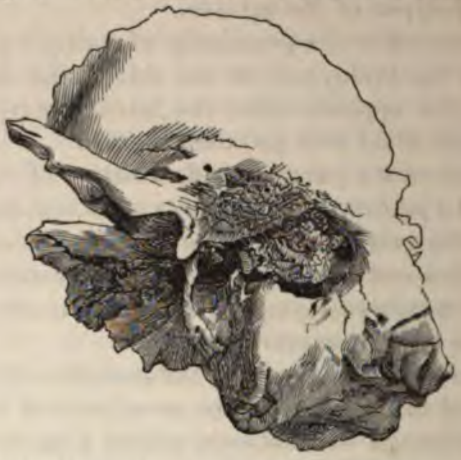
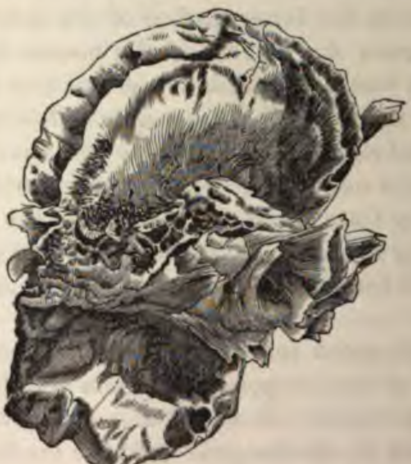


Fig. 63.—Posterior View of Temporal Bone.



The meatus should not be stopped with cotton, nor should astringent injections be resorted to until all the inflammatory action has subsided and passed away. If these active measures are neglected, we find death soon follow; whilst post-mortem examination reveals pus in the mastoid cells, and internal ear, and even portions of the temporal bone destroyed.

The subjoined cases* exhibit how rapidly grave results may follow from caries of the temporal bone, a result of neglected otorrhœa.

"Dr. E. H. Bennet showed to the Pathological Society of Dublin two specimens illustrative of the fatal results of caries of the temporal bone. Both patients were women, and had, previously to their fatal illnesses, enjoyed good health, with the exception of occasional slight otorrhœa. The first patient, aged forty years, became suddenly excited, violent headache set in, and in two or three days she became comatose, and never rallied. After death, appearances similar to those in fatal cases of cerebro-spinal arachnitis were noticed. An extensive decomposition of lymph had taken place in the pia mater beneath the arachnoid membrane. The lymph lay thickest close to the origin of the seventh nerve of the affected side; and around its insertion into the medulla oblongata, a perceptible induration existed. The lateral sinus was healthy, but the entire petrous portion of the temporal bone was softened and red. The portio mollis was adherent in the internal meatus, and the tympanum was destroyed. These latter lesions were evidently of an old date. The inflammatory action in the fatal attack had probably originated in the seat of the primary disease, and spread thence inward along the course of the portio mollis. The second patient, aged thirty-five, had been attacked with severe pain in the head. Sudden symptoms of general pyrexia followed, and shortly afterwards complete paralysis of the portio dura on the affected side. In this instance, death was clearly due to pyæmia, pleuritis and general pulmonic congestion having set in before death. Here, signs of meningitis were wanting; for, though the brain was somewhat congested, no purulent deposits had occurred. An encysted abscess was found in the temporal bone, and the petrosal and cavernous sinuses were full of purulent matter. Deposits of pus were discovered in the lungs. A remarkable symptom which had been present during life, was explained by the condition of the cavernous sinuses. This was the extreme distention of both conjunctivæ with serous fluid, the result of passive congestion in the ophthalmic veins. The nerve trunk of the portio dura had apparently been destroyed shortly before death."

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* British Medical Journal, December 24th, 1870; Medical News, Philadelphia, February, 1871.

CHAPTER XIII.

SUBACUTE, COMPLICATED, AND CHRONIC INFLAMMATION OF THE CAVITY OF THE TYMPANUM—CATARRH OF THE MIDDLE EAR (CATARRHAL DEAFNESS).

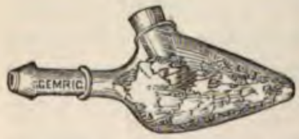
Of the affections of the ear, none occur more frequently, or require more care in diagnosis and treatment, than inflammation of the middle ear. It assumes three forms,—simple, complicated, and chronic. The simple form is a sequela of acute catarrh in children and adults; also bronchitis, pneumonia, etc. There is evidently swelling of the mucous membrane lining the middle ear, with or without a secretion of mucus or serum, and a discharge of mucus from the nose, with loss of hearing and a feeling of stuffing of the ears, as though a cloth had been placed over them; also an itching sensation, which the patient endeavors to relieve by pulling the ear upward and outward, producing more or less ringing, likened by the patients to the singing of a boiling kettle, puffing of a locomotive, and other similar sounds.

The objective symptoms are almost always a change in the secretion of the meatus auditorius to a yellow or a brownish-yellow. The cerumen assumes a darker tint, becoming almost black; and instead of remaining in thin layers on the sides of the meatus, runs together, forming a compact mass, covering almost, if not entirely, the membrana tympani. The following cases will illustrate the simple, subacute, complicated, and chronic forms. Detailed in this manner, we can best make it plain to our readers.

Case I. *Simple inflammation of the middle ear; catarrhal deafness following bronchitis.*—Miss L. T., aged eighteen, of New York, while convalescent from a severe attack of acute bronchitis, about the end of the second week gradually became deaf, with roaring in the ears, and had to be spoken to in a very loud tone of voice. She complained of a sensation of stuffing in the ears and nose, and heaviness of the head. On examination, the meatus was found covered with large scales of epithelium. The cerumen was very dark colored, and a delicate pellicle covered the membrana tympani. The nose and pharynx were swollen and red. On testing her hearing by my watch, she could only hear it with the right ear when in close contact, and with the left at a distance of one inch.

Treatment.—A wash of bicarbonate of soda applied warm to the meatus, and a gargle of the same. Internal use of ten grains of chloride of ammonium every two hours in a mixture with sugar and water. The ears were washed out for several days, until all the brown cerumen and epithelium were removed. A solution of sulphate of zinc, one grain to the ounce of water, was afterwards injected to restore tone. This treatment improved the hearing, so that the watch could be heard at ten inches from the right and twelve inches from the left ear. Still, however, the sounds continued, and there was considerable discharge of mucus from the nostrils. Thudichum's douche was then employed, first with a solution of common salt and warm water, and subsequently with a solution of alum, which diminished the discharge after having been used seven or eight days. The hearing, however, was not restored. Politzer's air douche was then tried, first with air, subsequently with ether, and a mixture of ether and chloroform by means of Dr. Pomeroy's glass attachment (see Fig. 64). Five applications of this restored the hearing almost to its normal standard. A recent letter from her medical attendant states that she continues to hear almost as well as before her attack.

Fig. 64.



Case II. *Subacute aural catarrh, the result of an ordinary cold, which was increased by crossing the Atlantic; deafness of one ear for five weeks.*—Rev. B. C. D., aged fifty-five, Honolulu, sent to me by Dr. Goodell. While in England contracted a severe cold, which ran its ordinary course, with the exception of leaving him very deaf, first in both ears, subsequently the right. On examination, the same conditions were found as in the case before related. In the right ear he could hear my watch at about two inches distance. On closing the left ear, he had to be spoken to in a very loud voice, and it was with difficulty that he could understand. On the left, although the circumstances were the same, he could hear ordinary conversation, and my watch at a distance of thirty-six inches. After the same course of treatment with the right ear, the left ear meanwhile being closed, the watch could be heard at twelve inches, and conversation at twenty feet. As there was considerable roaring in the left, he was supplied with a Politzer's bag and inhaler, with tincture of iodine, to be employed until these symptoms had passed away.

CASE III. *Subacute aural catarrh of several months' duration; deafness unfits the patient for the performance of his duties.*—August 16th, 1870. Rev. M. W. C., aged thirty-six, born in Pennsylvania. While a pupil at the Divinity School, in this city, contracted a severe catarrh, with cough and general impairment of health. Has been under the care of Dr. H. Y. Evans, of this city; his general health had improved by the use of extract of nux vomica and iron; but he is so deaf as to interfere with his studies. Dr. E., therefore, sent him to be relieved.

Symptoms.—Left ear has a feeling of fullness, with great discomfort; watch heard only at three inches; in the right, could hear it at three feet; meatus normal; left meatus injected and swollen; membrana tympani congested along the handle of the malleus; light spot not well seen; left eye injected; left Eustachian tube contained mucus; right free.

Employed Politzer's method of inflation, with some relief to the feeling of fullness. Internal treatment, a mixture containing hydrochlorate of ammonia, ten grains, three times a day.

August 18th. Again employed the air douche. The hearing distance for the watch increased to six inches. As there was a nasal tone, with enlarged glands, Thudichum's nasal speculum was applied, and powdered alum was blown up the nostrils; the throat was penciled with glycerine and iodine, also gargled with alum and borax.

August 21st. Treatment has removed the nasal voice, and by the use of the douche the hearing has improved some fifteen inches; the patient desired to go to the country, and continue his treatment.

February, 1871. He was perfectly cured, and now performs his usual duties as a clergyman of a parish in Pennsylvania.

AURAL CATARRH AND ITS COMPLICATIONS.

The first complication with which we are apt to meet is a chronic affection of the Eustachian tube, and one of the most prominent symptoms is the increased resonance or reverberation of the patient's own voice. If the tube of only one side be closed, the tuning-fork will be heard more acutely in that ear. There is also more or less pain as an accompaniment. It is described as a biting or gnawing pain, but is not of long duration. There is also at times pressure and heaviness in the head, and in some rare instances we have noticed vertigo. The objective symptoms are increased, redness of the nostrils, with elongated uvula, and enlarged tonsils, extending to the pharyngeal extremity of the tube, which is seen rounded, swollen, and covered with a gray mucous secretion, when examined by the rhinoscopic mirror.

CASE IV. *A[illegible] ear of twenty-five years' duration, of left ear of three months' duration; pharynx. Eustachian tube, and* [illegible].—Mrs. Y., aged seventy, of Philadelphia. Has been very deaf in the right ear for twenty-five years, in the left ear for three months, so that she could not hear ordinary conversation, unless the voice was so much elevated as to be painful to others. The watch could not be heard on either side; could hear the tuning-fork on both, but best on the right; meatus of both ears very dry; membrana tympani of right ear retracted, opaque; handle of malleus could not be seen, and no light spot; left membrana tympani not so opaque, more normal in ature. There was a small ulcer in the nostril, and the ynx was much reddened and thickened; cough in the lug from accumulated mucus. Eustachian tube of right evidently closed, left side was open, and gave a very oist sound.

osis.—Catarrh of middle ear involving Eustachian tubes, membrana tympani, and pharynx, following an attack of pneumonia.

Treatment.—Light penciling of the ulcer in the nose with solid nitrate of silver; dressed with ungt. hydrarg. nitr. and cerat. aq. rosar., equal parts. Snuff, for catarrh of pharynx, of powdered cinchona and cubebs. Politzer's douche to inflate the middle ear on the left side, changing it occasionally to the right side, with vapor of iodine, with inhaler, introduced by Dr. Roosa, the object being to diminish the thickened condition of the mucous membrane of the middle ear. A solution of sulphate of zinc was also injected into the Eustachian tube by Bishop's nebulizer; subsequently, by Eustachian catheter with double opening (see Fig. 92). The solution of chloride of ammonium was also used by the same means. Dr. Solis Cohen kindly assisted me.

Internal treatment, fifteen grains of the hydrochloride of ammonium with sugar, three times a day.

Local treatment of pharyngeal mucous membrane by means of gargles, insufflation of powders of tannic acid, etc. This treatment continued through March, with slight improvement. By the 10th of April she could hear her own watch with left ear, and the voices of her children. Throat less injected. On the 20th of April she could hear her watch faintly with the right ear, which she had not done for twenty-five years.

She continued under treatment until July 6th, when she was satisfied with the extent of the improvement. The left ear was entirely restored to its former normal condition, but the improvement in the right did not continue; she lost the power of hearing the watch, but was able to hear general conversation much better than before treatment.

CASE V. *Aural catarrh, with obstruction of the orifice of Eustachian tube, etc.*—E. W. G., aged twenty-eight, of Centre County, Pennsylvania. Has been deaf for five years, but only noticed it during the last three years. Has never had any severe disease except sick headache, and great liability to take cold. The progress of the deafness has been slow, yet getting worse each year. Very much increased during the last twelve months. Cannot hear general conversation.

No hereditary disease. His mother, a sister, and brother are deaf. Has been under treatment occasionally for two years. Visited me for the first time in September, 1869, but had not time to be treated.

Present condition.—Has never had pain; general health good, except sick headache from excess of food; bilious habit, yet regular in his bowels; sleeps well; noise in both ears, even in his best ear, after taking a cold from having his hair cut in cold weather; speech thick and nasal. Examination of tonsils found them very much enlarged, with thickening of the uvula, and chronic pharyngeal catarrh; no doubt this condition, acting upon the orifice of the Eustachian tube, displaced it, which was shown by the use of the rhinoscopic mirror. There was also hypertrophy of the glands, with swelling and hyperæmia of the mucous membrane. Right ear, meatus irritable; membrana tympani normal; light spot seen; hearing distance, September 16th, 1870, four inches. Left meatus, no cerumen; appearance, membrana tympani normal; Eustachian tubes open with difficulty, requiring a very strong blast of air through the Eustachian catheter; left, moist; right, dry.

Treatment.—Had applied to tonsils various agents to diminish their size; the best result was obtained by painting them with tincture of iodine.

September 17th. Removal of a portion from each tonsil by the knife; then applied the pencil of caustic soda and lime. This was continued every second day until they were reduced to one-half their former size. The Eustachian catheter was introduced every day until the 28th. On that day there was less noise in the ear, and Politzer's apparatus was then employed with success.

On the 29th September, hearing distance of right was seven inches; left, fourteen inches. Hearing distance for general conversation so much improved that his friends congratulated him on the wonderful change.

September 30th. Again employed the air douche, with increased improvement in both ears. He had now to leave for home, owing to the sickness of one of his children, and promised to return if the improvement was not permanent.

This is the third or fourth case in which the removal of enlarged tonsils and uvula has been of most decided advantage both to the voice and hearing. In numerous other cases we have known the tonsils to be entirely removed with so little care, that not the slightest improvement to the hearing of the patient resulted.

CASE VI. *Chronic catarrh of the middle ear, Eustachian tube, and membrana tympani; five years' duration (complete deafness of both ears); no improvement.*—Mrs. Mary S., aged twenty-four, born in Lancaster County, Pennsylvania, of German parentage, has been deaf for five years. General health good, menstruation regular, no children, no deaf relations. According to her statement, five years ago she went to a party, and, after becoming heated, with the same dress on drove to the sea-beach, and there took a bath. This was followed by a severe cold, which left her completely deaf. She applied to numerous irregular (so-called) ear-doctors, who placed various oils, etc. in the external ears without benefit. About one year since she placed herself under the care of Dr. James Collins, a well-qualified surgeon, who has given the subject of aural affections considerable attention. His diagnosis was "chronic aural catarrh," for which he treated her after the most approved method for one year, without any favorable result. He then sent her to the Howard Hospital.

Objective Symptoms.—Meatus auditorius of right side dry; membrana tympani resembling parchment; no bright spot; handle of malleus invisible; has pain over the nose, and discharge of an offensive character, indicating ozæna, disease of the mucous membrane lining the nasal bones; can only hear a trip-hammer or the rumbling of a car; a small amount of air entered the Eustachian tube by forcing it with an air-pump or the hand-apparatus. Right ear sensitive to electro-magnetic current when filled with salt and water; left, when filled with the same fluid, not sensitive with the conductor in the meatus.

Diagnosis.—Aural catarrh (*sclerosis*) of the mucous membrane of the middle ear.

Prognosis.—Almost hopeless.

Treatment.—Bichloride of mercury and hydrochloride of ammonium, with iodide of potassium, oil of hyoscyamus per coctum; perforation of the membrana tympani, and injection of fluids into middle ear; application of the induced current and the use of Politzer's and Thudichum's douches, all of which has been carried out without benefit.

The treatment was continued for three months, resulting in but very slight benefit to her hearing, but her catarrh and ozæna were much improved. She was recommended a Haswell's ear-trumpet.

In the abstract of the proceedings of the Otological Congress,* held at Dresden, September, 1868, furnished by Dr. Roosa, the treatment of non-purulent catarrh of the middle ear was discussed, and Pagenstecher's nomenclature was adopted as the basis:—1. Hypersecretion; 2. Vascular ectasia; 3. Sclerosis.

In the first-named form the use of the catheter with air, vapor of the muriate of ammonia and injections, Politzer's method, internal use of quinine, iodide of potassium and iron, rubbing the skin, treatment of the naso-pharyngeal membrane by gargles and injections, and paracentesis of the membrana tympani, were the remedies spoken of.

In the second form, no irritants should be used. The internal use of acids and the application of the artificial leech were recommended.

In the third form the injection of irritants was advised. One of the members of the Congress had used a solution of atropine (grs. ij to f℥i), poured into the ear, with benefit in some cases, so far as diminishing tinnitus was concerned. This we consider too strong a solution to be employed without a great deal of care. We think even grs. ij to f℥i of water a very strong solution, for fear of a slight perforation or the Rivinian foramen allowing a portion to pass into the throat by the Eustachian tube. Obturation of the canal, as suggested by Politzer, had been practiced; but one delegate (Hinton) had not seen any benefit from this procedure. In the first class of cases almost all recover; in the second, one-half; in the third, one-sixth; and in the fourth, they are obliged to adopt a good hearing-trumpet.

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* Transactions American Otological Society, second meeting, 1869.

PATHOLOGY OF CHRONIC AURAL CATARRH (CAVITAS TYMPANI, OR MIDDLE EAR).

According to the late Joseph Toynbee,* the cavity of the tympanum, or middle ear, when diseased, contains the following abnormal contents: pus, mucus, serum, epithelium, lymph, blood, cholesterine, scrofulous, oily, and calcareous matter. He describes a case of chronic catarrh, in which he made a post-mortem examination, and found mucus escaping from the tympanum through an orifice in the membrana tympani, not normal, but thick and dark-colored, and distending the cavity (showing one of the most common complications).

No. 279 in his Catalogue. The tympanum nearly full of firm lymph.

No. 280. Right ear.—The tympanum contains a mass of soft, pale substance, which surrounds the stapes, and partly conceals the other ossicles. History.—Male, aged seventy-nine; deaf for four or five years; the deafness came on slowly from cold. The right ear was the worst. He could hear the click of the nail. This man, while living, suffered from a feeling as of stopping up on the right side of the head, and from a noise like the ticking of a clock, which was worse during a cold. The membrana tympani, on examination, was seen to be white, concave, and thick. The act of blowing the nose was accompanied with a feeling of cracking and bursting in the ears.

No. 280a. Right ear.—The meatus contains purulent fluid and thickened epidermis. The membrana tympani had fallen into the promontory, and was of a dark color, and thick. The anterior part of the tympanum is filled with a firm mass, resembling a partially-decolorized clot; the posterior part is filled with a clot of comparatively recent blood, which appears to extend into the mastoid cells. The malleus and incus are freely movable; the base of the stapes is somewhat less movable than natural. History.—Male, aged seventy-nine. At times, when a boy, was hard of hearing, which he attributed to bathing; for fifty years had been decidedly deaf; the deafness varied much, being worse during a cold. He could hear a loud voice, but had a beating noise in his head. Died from cancer of the liver.

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* Toynbee's Descriptive Catalogue of Preparations Illustrative of Diseases of the Ear, in the Museum. London: John Churchill, 1857.

Nos. 281, 282. From a girl, aged two and a half years, who died from phthisis. Right ear.—Membrana tympani entirely destroyed by ulceration. The tympanum contained some scrofulous matter, although the lining membrane was so swollen as nearly to fill the cavity. Left ear.—Membrana tympani thick, white, and soft; the mucous membrane of the tympanum very thick and red. The tympanum was nearly filled with mucus, so dense as to be almost solid. Examined by the microscope, this substance was found to be mucus, in combination with scrofulous matter.

Two other cases, containing the same product, but no history of deafness during life.

No. 286. The tympanum contains calcareous matter, deposited chiefly upon its inferior and posterior walls.

No. 287. The incus dislocated, impacted in the mastoid cells, and surrounded by calcareous matter. No history of deafness.

No. 288. Mucous membrane very thick. No history of deafness.

Nos. 289, 289a. Strong bands of adhesion between the membrana tympani and incus. No history of deafness.

No. 305. From a woman, aged sixty-two, who died from gangrene. Deaf in left ear. Left ear.—Membrana tympani white, and very concave. Around the point of attachment of the malleus the blood-vessels were enlarged and distended with blood. The tympanum had three parts filled with a thick, tenacious white mass, which was partly the cause of the white appearance of the membrana tympani. The mucous membrane of the tympanum was thick and very vascular, and that portion of it which covers the body of the incus was red. In the succeeding twenty-four cases, although the mucous membrane was diseased, there was no history of deafness during life. We shall select only those cases in which a history of deafness is given.

No. 316. A portion of a greatly thickened mucous membrane from the tympanum of a man deaf since early life,—the cause of deafness having been scarlatina.

No. 326. From a woman aged thirty-eight, who died of dropsy. Deaf. Right ear.—Membrana tympani dull, more concave; tympanum was nearly filled with a firm gelatinous-looking substance of a red hue, and the mucous membrane of the tympanum was in a highly tumefied condition.

No. 327. Right ear.—Membrana tympani white and soft, and in a state of ulceration; mucous membrane of tympanum thick, soft, and ulcerated. The tympanum contained a large quantity of white muco-purulent fluid. The dura mater was separated from the mucous membrane of the tympanum by a very thin layer of bone, to which the latter was very slightly attached.

No. 328. Female, aged twenty-nine. Died of jaundice, with diseased liver and kidneys. She was deaf in the right ear, in which she had frequent gatherings, ending in a copious discharge. She also suffered from violent pains in the head, which at times were almost intolerable, but these were relieved by the discharge.

No. 333. From a woman aged twenty-two. Deaf. Died from disease of the heart. Right ear.—The mucous membrane of tympanum and mastoid cells was much thicker and softer than natural.

No. 338. From a man aged sixty-eight. Deaf in right ear. Membrana tympani destroyed; the lower two-thirds of the long process of the malleus removed; the mucous membrane of the tympanum ulcerated; the cavity full of thick soft membrane and offensive discharge.

Fifty cases contained membranous bands of adhesion, and four were deaf prior to death.

No. 341. From a man, aged forty-four, who died of diseased bladder. He had been growing gradually deaf during many years. The Eustachian tube was pervious. Right ear.—The mucous membrane of the tympanum was thick, and bands of adhesion connected the stapes, malleus, and incus to the membrana tympani.

No. 342. From a man aged seventy. Died of disease of the heart. Hard of hearing. Right ear.—Membrana tympani of a dull lead color, but much thicker than natural; the tympanum completely full of cellulo-fibrous tissue, which connected the ossicles and the membrana tympani to the promontory.

No. 345, 346. From a man aged seventy. Had been deaf in the left ear since the battle of Trafalgar. For three weeks after the battle, was almost entirely deaf, but afterwards became better. During the four years preceding his death became more deaf; subject to noises of a tinkling character in the left ear during a cold; could hear a watch on pressure over right ear; with the left could hear a click of the finger-nails. Right ear.—Membrana tympani thick and concave. Numerous bands of adhesion connected the ossicles to the tympanic walls and to the membrana tympani. Ossicles not so movable as natural. Left ear.—Membrana tympani destroyed, except a narrow portion posteriorly. The ossicula remain, and are connected with each other and attached to the tympanic walls by broad bands of adhesion. The tympanum contained a secretion of a black color.

Nos. 347, 348. History. ——, male, aged sixty-seven. Had been deaf for thirty or forty years after a naval engagement. Was subject to roaring noises in both ears, which sometimes ceased for a day or two. At times there had been a discharge from both ears. Up to about two years before his death, he could hear the click of the finger-nails with each ear, but before he died he became unable to hear the voice. Right ear.—Membrana tympani, lower two-thirds destroyed; the lower margin of the upper third was attached to the thick mucous membrane of the tympanum, which shuts off the mastoid cells from the tympanic cavity. The mastoid cells were full of a dark-colored serous fluid, epithelium, and cholesterine. Mucous membrane of tympanum very thick; labyrinth healthy. Left ear.—In the same state as the right ear, except that the fluid in the mastoid cells was transparent. The stapes was fixed. The mastoid cells were separated from the tympanic cavity by a distinct band between the inner wall of the tympanum and the upper part of the membrana tympani.

Then follow thirty-three cases in which bands of adhesion were found extending across the tympanum, binding the small bones or the membrana tympani. No deafness recorded.

No. 401 to 410. *The canal for the portio dura nerve imperfect.*

Nos. 410, 410a. *The superior osseous wall hypertrophied.*

From a man, aged eighty-five, who had been deaf for many years. Right ear.—The meatus externus contained a large mass of hardened epidermis, pressing on the membrana tympani, which was opaque. The tympanum contained muco-purulent fluid. The superior wall of the tympanum was greatly hypertrophied, being more than half an inch in thickness. The canal for the carotid artery was greatly contracted. Left ear.—The superior wall of the tympanum was similarly hypertrophied. The canal for the carotid artery was contracted to a less degree.

No. 411. *Superior osseous wall expanded.*

No. 412 to 450. Superior wall partly deficient; the mucous membrane of the tympanum being more or less in contact with the dura mater.

No. 453 to 482. The inferior osseous wall deficient; the mucous membrane of the tympanum being more or less in contact with the outer surface of the jugular vein.

CONCLUSIONS IN REGARD TO THE PATHOLOGY OF DISEASES OF THE MIDDLE EAR.

From the cases here given, we may glean the following important facts in regard to the pathology of the middle ear: that it contains abnormal products of inflammation, given in detail above, which have been confirmed by puncturing the membrana tympani during life, and there have been found pus, mucus, and serum; also calcareous deposit upon the membrana tympani, and it is to be inferred that the wall participates in the same deposit, as just shown. There has been seen soft and hard lymph surrounding the malleus, incus, and stapes, and, as a matter of course, preventing their proper vibration. There are also deposits of blood. These results have been confirmed by Von Tröltsch and others. The mucous membrane is thickened, vascular, and diseased, with bands of adhesion connecting all the bones of the ear, affecting the movements of the same, and the fenestra rotunda and ovalis.

It has also been found that the superior osseous wall of the tympanum has become greatly hypertrophied, and the walls expanded, with the superior osseous wall so deficient that the mucous membrane of the tympanum is brought in contact with the dura mater, and that of the inferior also, so that the mucous membrane is more or less in contact with the outer surface of the jugular vein; both are avenues to disease of the blood and brain.

As the pharynx and Eustachian tubes are apt to become involved, we shall describe some of the changes produced upon these important parts by this disease.

They have been found dilated, the tubes being very large. There are also strictures of the same caused by *hypertrophy of their bony walls.*

No. 487. A male, aged seventy, became deaf four years before his death, after sleeping in a damp bed. He required to be spoken to in a loud voice within two yards. The tympanum was full of a dark slate-colored fluid, which gave a color to the membrana tympani, and the upper wall of the tympanum.

No. 488. Eustachian tube impervious at its entrance into tympanic cavity; membrana tympani very thick.

No. 489. History. ——, male, aged sixty-six, had been deaf for about seven or eight years, attributed to cold. The Eustachian tube was so much contracted at the part where the cartilaginous is continuous with the osseous portion, that it only just admitted the passage of an ordinary-sized pin.

No. 491. Eustachian tube and tympanic cavity full of dense fibrine.

No. 494. A man aged fifty-two, who died of dropsy, was deaf, and the stapes was completely anchylosed to the margin of the fenestra ovalis.

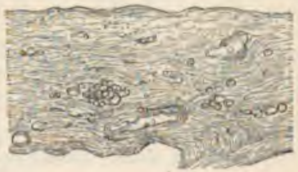
There are numerous cases of complete anchylosis of the stapes and other bones; partially anchylosed, one hundred and thirty-four cases in all.

Then fracture of the inferior extremity of the malleus; handle of the malleus carious from a youth, aged ten; effect of scarlatina; case of caries of malleus and incus; also, one of caries of malleus. Then follows caries of incus and stapes.

It will be seen that he makes an important distinction between complete and partial anchylosis; in other cases it was simply more firmly fixed than natural, by bands of adhesion in the tympanum. In those recent cases, when the lymph is soft, proper treatment may overcome this condition.

Von Tröltsch* observes, under the pathology of aural catarrh, that "the muco-periosteal lining of the osseous middle ear, which for the sake of brevity we call a mucous membrane, has as yet received no complete microscopic examination as to its condition in a state of health." He also states that our knowledge and ideas of the morbid changes in chronic aural catarrh are still in a somewhat crude condition; that they are chiefly confined to what may be observed with the naked eye; and that we do not yet properly understand the finer changes in the tissue of the middle ear.

Fig. 65.



To illustrate these changes, Prof. Gruber has devoted much attention to this subject, and in his recent work has furnished two illustrations. The first (Fig. 65) is a view of a microscopical section of an inflammatory hypertrophy of the mucous membrane of the tympanic cavity, thickened to five times its normal condition. Chalky masses are seen scattered through the tissue, which, on the addition of muriatic acid, exhibit the usual reaction.

The following statistics show the result of treatment of chronic catarrh, or chronic inflammation of the middle ear, by Prof. S. Moos, M.D., of Heidelberg:*

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* Von Tröltsch on the Diseases of the Ear, p. 282.

Whole number of cases.	Cured.	Improved.	Unimproved.
100	17	64	19

These we consider very good results, to save from permanent deafness seventeen out of one hundred, or over five per cent.

Dr. H. Schwartze, of Halle,† a highly respected and successful aurist, reports seventy-three cases treated with the following results:

Whole number of cases.	Cured.	Improved.	Unimproved.	Not treated.
73	7	32	8	26

Following these we have the cases of another careful and exact writer, Prof. Roosa,‡ of the University of New York:

Whole number of cases.	Cured.	Much improved.	Improved.	Unimproved.	Unknown.	Died.
245	11	17	56	96	64	1
254§	12	32	55	75	95	

We here give our own‖ results. See Table, p. 56.¶

Whole number of cases.	Cured.	Improved.	Unimproved.	Not treated.
111	12	51	39	9

We derive from the table of Prof. Gruber,** of the General Hospital, Vienna (Austria) the following results:

Remaining Dec. 1867.	Admitted.	Cured.	Improved.	Not cured.	Not treated.	Remaining end 1868.
45	142	33	72	8	18	56

We shall also extract from Gruber's valuable work, published in 1870, his observations on prognosis and treatment, as it is our desire to present to our readers the latest views upon this frequent and most serious disease of the organ of hearing.

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* Klinik der Ohrenkrankheiten, von Dr. S. Moos, Docent in der Universität in Heidelberg. Braumuller, Wien, 1866, p. 348.

† H. Schwartze, Halle, Praktische Beiträge zur Ohrenheilkunde. Wurtzburg, 1864, p. 48.

‡ D. B. St. John Roosa, M.D. Transactions of New York Medical State Society, 1868, p. 260.

§ Later published table of four hundred and ninety-four cases of disease of the ear, by Prof. Roosa, April, 1871. Am. Jour. Med. Sciences, p. 392.

‖ Turnbull. Clinical Observations, Howard Hospital, etc., 1870.

¶ The author regrets that an error has occurred in his table in the cases of chronic catarrh, which are marked perforated, which is not correct.

** Report of Diseases of the Ear, in General Hospital in Vienna, by Dr. Joseph Gruber, during the year 1868. See table.

Dr. Gruber* states that "catarrhal inflammation of the middle ear, in general, admits of a favorable prognosis, provided it has not lasted too long, or has attacked an individual otherwise healthy, and has not produced an injury, difficult to heal or incurable. In the latter case the condition of the tympanum and auditory ossicles must be particularly considered. A complete recovery can hardly be expected with a total destruction of the membrane of the tympanum; nor can the faculty of hearing be restored when the bones are separated from their connections, or exfoliated. The prognosis is likewise more unfavorable when the individual suffers from constant tinnitus, especially when the latter does not entirely disappear after the application of the air douche,—secondary alterations, which cannot be relieved by art, having taken place in the labyrinth and fenestræ. The prognosis is, however, most favorable in those cases in which, after the application of the douche, the tinnitus has entirely ceased, the faculty of hearing is restored, and the patient is not afflicted with other diseases which might cause a relapse of the aural affection. If the disease has been of long standing, although the patient be otherwise well, a perfect cure cannot be promised, as the douche does not restore the hearing, and the tinnitus will continue.

"The application of the tuning-fork as an auxiliary to prognosis, although recommended by many, is by no means reliable.

"The treatment is not only to relieve the local affection, but also to prevent the possibility of relapse. Concerning the latter particular, the bodily condition of the patient should be carefully considered, and lesions which may present themselves should be appropriately treated. Especially should we endeavor by every available means to counteract such diatheses as the scrofulous, tuberculous, syphilitic, etc., which most frequently keep up obstinate catarrh of the middle ear. In such cases the local applications are from the beginning to be united with suitable constitutional treatment, the latter being even continued for a long time, although the former may have already answered their purpose, since relapses giving rise to an incurable affection are very liable to occur. The local treatment should extend to all the neighboring organs when they are similarly affected, or when their lesions have originated the existing disease. In the latter case, the rhinopharyngeal region should be attentively inspected, and the disorders there exhibited most energetically and skillfully combated; the new formations met with in that region, so frequently causing catarrh of the middle ear, should be extirpated as soon as possible, and the fundamental disease treated appropriately.

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* Lehrbuch der Ohrenheilkunde, pp. 469–487.

"Hypertrophied tonsils are very frequently the fundamental cause of catarrhal inflammations in the pharynx and middle ear, and should not escape the attention of the physician. In such cases, I prefer the extirpation of the whole tonsil, or the excision of a part of it, not the application of caustics or astringents. It is easily performed with Fahnestock's instrument, modified by Linhart, the consecutive treatment being finished within six days, the organ which is removed being possessed of very trifling physiological use; should the patient not submit to the operation, a solution of nitrate of silver, ʒ½–ʒi to f℥ss–℥i of distilled water, or powdered alum, may be applied. For this purpose I frequently employ forceps made of hard caoutchouc. A tuft of lint, or a small sponge, used as a vehicle for the medicament, is brought by means of this instrument to the place that is to be cauterized. On its rings there are two hooks catching each other, by means of which the forceps can be firmly closed. The cauterization is effected once a day, or at longer intervals, to be continued as long as requisite.

"With regard to the employment of gargles in the catarrhal affection of the nasopharyngeal mucous membrane, if they fail to give the desired result, from occlusion of the fauces by muscular action, I advise the patient to bend the head backward as much as possible, and, avoiding the motions usual in gargling, to bring the remedy in contact with the diseased portion alone. To reach the diseased mucous membrane in the catarrhal affection of both the nostrils and superior part of the pharynx, the injections of remedial fluids through the nostrils recommended by me* are most serviceable. Solutions of alum, borax, or tannic acid, grs. xx to ʒi, in distilled water, one pound or pint, are most applicable to them. The several injections are to be repeated after the reaction produced by the preceding application has subsided.

"For the treatment of catarrhal affections of the nasopharyngeal mucous membrane, it is not necessary to irritate the other nostril during the injection; but if the fluid is to be injected through the Eustachian tube into the middle ear, it should be introduced by pressing the corresponding ala nasi to the septum nari, in order to bring the injected fluid with more or less force, and to a certain extent to its place of destination. The snuffing up of astringent remedies, which is frequently recommended, is not as effectual as their injection; since, in the former case, they will reach only the anterior third of the nostril. Alum, or some other astringent finely pulverized, together with sugar, one to six, or even in equal parts, is generally used for snuff powders. I have never observed the disadvantage ascribed to injections into the nostrils, namely, that of impairing the sense of smell, to have been of long duration. What has been said about the catarrhal affection of the rhinopharyngeal mucous membrane, as well as the increase of the tonsils, with reference to the catarrh of the middle ear, is applicable, also, to all the other morbid conditions of that region accompanying the diseases of the ear, in so far as they are also to be treated *secundum artem*. To enlarge upon them is out of place in this connection. It must, nevertheless, be mentioned, that especially the healing of pharyngeal ulcers, as well as the appropriate treatment of a polypus, must be instituted from the beginning, as otherwise they will always constitute a new cause of disease. With the treatment of the morbid affection in the pharyngeal region, that of the middle ear is to be connected. The condition of the Eustachian tube is, therefore, to be examined. When it is swollen at its orifice, and no other changes are discernible in its course, the above-mentioned treatment will often suffice to effect a cure. When there is at the same time a catarrhal disease of the pharyngeal mucous membrane, the injections above recommended are to be immediately followed by Valsalva's method. Did the catarrh at the orifice of the Eustachian tube, on the contrary, combine only with a simple pharyngeal affection, the astringent gargles above mentioned must be employed, and the orifice of the tube cauterized. With those who cannot bear cauterization, the astringents may be applied in spray, to which the universal pulverizer, made according to the principle of Richardson's anæsthetic apparatus of the corresponding length, the bend being given to the tube, through which the sprayed fluid is emitted, is applicable. From this time it is advisable frequently to employ the air douche for opening the tube, which will free the patient from the most disagreeable sensation of pressure in the diseased ear, owing to the inward inclination of the membrane of tympanum; after the absorption of the air in the cavity of the tympanum, the hearing is improved, at least momentarily.

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* Incline the head to the affected side; place in the nostril of the same side a glass or elastic syringe (or glass tube), containing about ʒij of the required solution; this is either poured or syringed into the pharynx, where it comes in contact with the orifice of the Eustachian tube. Then inflate the tympanum without swallowing.

"It will occur, not unfrequently, that catarrhal patients do not apply for medical assistance until after the acute inflammation has already disappeared, its product only remaining as a mucous plug in some portion of the tube, generally its orifice, which will be most apt to accompany the rhinopharyngeal catarrh. Such a ball, especially when tough and closing the tube, may be the primary cause of the affection. It should be removed by means of the air douche, or dis[illegible] to occupy some section of the middle ear, [illegible] as, for instance, in the cells of the [illegible] the cure of the disease will sud[illegible]. When the patient comes under [illegible] the swelling of the mucous membrane and the hypertrophic condition still continue, the air douche should be applied for the removal of any collection in the middle ear. However, its application is admissible only when absolutely needed, and then with the greatest precaution.

"There will be some cases in which the catheter, under the application of the air douche, is to be introduced even into the tube, and others in which Politzer's method is indicated. With children, and those in whom natural impediments are met with during the introduction of the catheter, only the air douche without the catheter is applicable. I deem the same proceeding applicable to this object where the catarrh in the middle ear is associated with inflammation of the nasal mucous membrane; but the frequent application of the catheter will become most disagreeable to the patient, the mucous membrane of the nostrils being always irritated by its introduction. In such cases, therefore, the air douche without the catheter will be more beneficial. If, on the contrary, only the middle ear is diseased, the pharyngeal or only the nasal mucous membrane being normal, I think Politzer's method, if practiced for a long time, is not beneficial, because the air is pressed by it into the nostrils, and must penetrate in all directions for an escape in the rhinopharyngeal region, as the pharynx is closed below by the motions of deglutition. It will, therefore, spread in the nostril in all directions, passing into all the neighboring spaces. In this way the nasal mucous membrane may be injured; the action of the air forced into the lachrymal duct will injure the latter, and even the conjunctiva. This is, indeed, no theoretical induction. I have too often had patients with whom this method was practiced for a long time, and who complained of various affections of their eyes, especially catarrh of the conjunctiva, and a most annoying dryness, together with a feeling of pressure in the eye. On this account I prefer the air douche, with the application of the catheter, in all those cases in which it can be applied, and in which the rhinopharyngeal mucous membrane is uninjured.

"With regard to the air douche in catarrh of the middle ear, the condition of the tympanum must also be taken into consideration; and it should be remembered that this membrane is often very brittle. Upon the application of the catheter, the air may be pressed into the cavity of the tympanum with regulated power, which cannot be done in Valsalva's method, the bag being emptied with vehemency in the short moment of deglutition, and the tympanum pressed outward so forcibly that it may rupture. From the indications which we have hitherto stated for the employment of the air douche, it will become apparent that in many cases it will suffice to apply it once, whereas in others it must be employed as often as the secretion collects in the tube and cavity of the tympanum and gives rise to morbid phenomena. In such cases it always has the object of removing the inflammatory product. It may become beneficial, also, in those cases in which there is no collection of morbid matter, but the swelling of the tube may have terminated by closing it, or producing secondary alterations in the cavity of the tympanum. In such cases the air will make its way through the narrowed tube, and, passing into the cavity of the tympanum, press the membrane outward, together with all the ossicles of the ear. In this manner the patient will be freed, for a longer or shorter time, from the annoying subjective symptoms. The pressure which the air exercises during its passage through the tube and into the cavity of the tympanum upon the swollen mucous membrane is, on the other hand, not unequal, in its effect, to the compression of other swollen organs. Consequently it promotes absorption, and to this circumstance no less than to the beneficial influence which the ventilation of the middle ear exerts, I ascribe the complete cure obtained by the skillful application of the air douche, in many cases of acute catarrh complicated with considerable swelling of the mucous membrane.

"The mucous membrane, in the whole middle, is sometimes extraordinarily inflamed from the commencement of the catarrh. This hyperæmia is then not confined to the middle ear, but extends over the labyrinth, and not unfrequently to the deeper organs of the external ear. The subjective noises will, in such cases, be increased, and the objective changes revealed by a high degree of hyperæmia in the tympanum. Local bleeding should then be used, the number of leeches to be applied being in conformity with the objective changes and the strength of the individual. Though I must generally deprecate the frequent abuse of local and general bleeding in diseases of the ear, yet I cannot help intimating, on the other hand, that by restricting bleeding to those cases in which the vascular depletion tends only to mitigate the pain, sins of omission may be committed which the physician will afterwards deeply regret. When, in catarrhal inflammation, such local bleedings are made under the indications above mentioned, their beneficial effect will be immediately manifest, especially in regard to the noises heard in the ear. If this is not the case, after the depletion has been performed twice or thrice, at intervals, it will be unavailing, although it should be renewed more frequently. If it then fail, it is owing to secondary changes that have taken place in the labyrinth. Cutaneous irritants, particularly the vesicants and ointments so much patronized by the public, in spite of their painfulness, when applied to the skin about the ear are not as beneficial as local bleedings; in many cases they are very inefficient.

"In severe catarrh the bowels will frequently be irregular, and the patient feels much relieved when their action is promoted by laxatives, or stronger saline purgatives, suited to the circumstances. The regular use of mineral water, especially when indicated by constitutional ailments, is likewise attended with benefit, and I have derived very satisfactory results from the use of the springs at Friedrichsthal, Marienbad, Karlsbad, Rakóczy, etc., when there was a great predisposition in the patient, and the local treatment did not suffice. If the catarrhal affection is treated from its beginning according to the rules hitherto laid down, and with the remedies mentioned, the patient being otherwise healthy, and a suitable regimen followed, the disease will yield, at the most, after a few weeks. Should this not be the case, and the disease confined to the mucous membrane, a copious product of inflammation resulting, the injection of astringent fluids into the middle ear may be introduced by means of the catheter. Such injections are, however, injurious, when they are performed at the beginning of the disease, or in cases of hyperæmia of the mucous membrane, since they will increase it, whereas the simple air douche, properly applied, will prove truly beneficial. Should the catarrh threaten to become chronic, the mode of life of the patient is to be regulated, and whatever has an injurious influence upon the disease is to be forbidden. He should quit his occupation if it influenced the disease.

"Exercise in the open air should be taken; fats, stimulants, and all stimulating food must be interdicted. Sleeplessness should particularly be avoided. I have frequently made the observation, that catarrhs which had lasted for weeks, suddenly disappeared when the patient had left the city to live in the country. This beneficial effect becomes more marked by change of climate. Medicaments applied externally, as a matter of course, have but little influence upon the mucous membrane of the middle ear. As long as the membrane of the tympanum is not perforated, such medication—as, for instance, the dropping of fluids into the external auditory passage—is apt to increase the original morbid process by stimulating the parts with which it comes in contact, and should, therefore, be discarded. It cannot be denied, however, that the application of absorbents around the ear may occasionally be of the greatest, though indirect, service for the relief of secondary ailments. This is especially the case with the preparations of iodine and mercury, being most serviceable in chronic catarrhs depending upon a scrofulous or syphilitic diathesis. The application of medicines upon and over the external ear may promote the cure of the disease, when the membrane of the tympanum is perforated, or the external meatus presents such objective changes as require the application of medicaments. The penetration of such fluids into the cavity of the tympanum, as a matter of course, is subjected to certain conditions, of which we have already treated.

"We must, however, cursorily repeat here, that even with a greater loss of substance in the membrane of the tympanum, the retrogression of the disease cannot be expected from the sole instillation of medicines in the catarrhal inflammation of the whole middle ear. If, in such cases and under such medication, no recovery ensues by the aid of nature, the patient may ineffectually employ the medicines best indicated, even to their own prejudice. The surest method of relieving the inflammatory affection is, in all cases where medicaments are indicated, the injection through the Eustachian tube. By instillation the auricle may be supported, if it is skillfully practiced, and the patient can do it without the assistance of the physician, but not without the knowledge of what has already been said and what will be said afterwards, otherwise the injury done may be greater than the benefit derived. In consecutive inflammations in the external ear-passage and the tympanum, the instillations of remedial fluids may be urgently indicated. In this respect we refer to what we have represented under the treatment of external otitis and myringitis, intimating that the attendant physician must always bear in mind that, in such cases, he has only the consecutive disorders to combat. He must attend principally to the original disease in the middle ear, acting at first more expectantly, unless changes occur which demand a quicker action.

"He will then frequently notice, with the diminution of the inflammatory symptoms in the middle ear, and particularly with the decrease of the fluid which, passing through the opening of the membrana tympani into the external ear, when copious, or of bad quality, constantly irritates the parts with which it comes in contact, that even the irritation thus produced will also gradually disappear, without any direct treatment having been required. On the other hand, the treatment of such conditions as might terminate unfavorably must not be delayed too long. The secondary straightening of the external auditory passage, owing to the swelling of its soft parts, for instance, demands quick dilating in the way before described. Polypous growths, produced from consecutive inflammation in the external ear, must likewise be timely extirpated, because the inflammatory products formed in the depth are prevented from being discharged, thus causing the inflammation to terminate most unfavorably. An important part in the treatment of catarrh in the middle ear was formerly played by the application of medicated vapors. Many authors, as, for instance, Von Tröltsch, still give them credit for a particular beneficial agency. I have, in former years, made use of them extensively, but in their use I have been convinced that the same result will be obtained in a more simpler mode, from the application of medicines through the Eustachian tube. Since that time I employ medicated vapors but seldom, particularly when the injections of fluids have proven successful, and I wish to do everything to moderate the distress of the patient; but such medication will then generally prove inefficient. This will not, however, imply that the medicated vapors are devoid of all healing power in the disease under discussion. They are, on the contrary, as efficient as the medicated fluids; but I believe the same result may be obtained by the latter means and in a simpler way. The action of vapors is more difficult, on account of their being employed at a higher temperature, which causes the mucous membrane of the tube to swell, whereby it is narrowed, so as soon not to admit the vapors.

"Of the various vapors employed, I must ascribe the greatest efficiency to a solution of common salt, ʒij to ℥iv of water. Besides, we have employed the solutions of borax and alum, of the same strength, the vapors of muriate of ammonia, tincture of iodine, the various ethers, acetic and pyroligneous acids, chloroform, pitch- or tar-water, etc. With the exception of those vapors which act as narcotics, contributing to the soothing of the subjective sensations, I should not like to attribute to them any preference, believing that in the future they will be less and less employed. It is, perhaps, principally the high temperature at which they are employed that constitutes their beneficial action, as the simple aqueous vapors would produce the same effect. Of the aeriform bodies, carbonic acid has especially been frequently tried in chronic catarrh, and its action praised. For this purpose it is developed from carbonate of lime and hydrochloric acid. The acid is gradually added to the lime contained in a bottle, the neck of which should be long. Experience, however, has taught that carbonic acid does not render greater service than the use of the medicated fluids. For their application the compressive apparatus before described may be used, or the vapor may be blown directly out of the apparatus into the tube by the mouth. Such bodies as will readily evaporate, and are applicable without aqueous vapors, may be simply put in a valved bulb, the air impregnated with vapor being driven in through the catheter. When the compressive apparatus is used, or the vapor is blown by the mouth into the tube, the vessel which contains the vapor or aeriform body must be provided with two glass tubes, bent at right angles and fastened in the stopper of the vessel. The end of the tube outside the vessel is to be connected with the compressive apparatus by means of a caoutchouc hose, the end of which is then to be joined to the catheter introduced into the Eustachian tube, in which way the vapors can be driven into the middle ear by means of the compressive apparatus. The vapors may be blown into the ear through the free end of the glass tube, which otherwise is connected with the compressive apparatus. If the fluid to be employed must be warmed, the vessel containing it should be placed in the sand-bath, or over a spirit flame. In the application of warm vapors (those of water are employed at a temperature of 35° to 60° Rem.), the catheter must be surrounded with a non-conductor—best an elastic tube, or simply some sticking-plaster—to protect the nasal parts from the high temperature.

"We must not fail to notice, in this connection, the pneumatic apparatus to which so much efficiency has been ascribed in the diseases under discussion. I am of the opinion that it can be reduced to the same principle as the above, viz., pressure of air; and our therapeutics has obtained no great result from it, since we have the means to heighten the pressure in a more direct way throughout both the tube and auditory passage as much as we please, without confusing the patient. Acute catarrhs will occasionally subside of themselves, without any assistance; and, in chronic cases, this apparatus will accomplish nothing.

"With reference to the use of various springs, I find that they are of no direct benefit to the diseases of the ear, but are indicated only to cure or relieve the general disorder with which the various inflammatory processes in the mucous membrane are connected, and which of late have been too much neglected by physicians. The use of salt, iodine, or iron baths must find a frequent indication, according to what has been shown under the head of Etiology. Salt baths are most effectual with individuals who, from the tenderness and great sensibility of their skin, are inclined to relapses; and Pagenstecher declares that the methodical use of warm baths had acted beneficially. He asserts that some patients had, at least, experienced no increase of their deafness from the use of the Weisbaden therms (hot springs)."

CATARRH OF THE TYMPANUM—PARACENTESIS OF MEMBRANA TYMPANI.

The operation of puncturing the membrana tympani has been employed since the time of Sir Astley Cooper, and is still resorted to for relieving a thickened membrana tympani. At one time it was highly lauded, and again much neglected, and was revived by Bonnafont and others, but never founded upon a true scientific and pathological basis.

The following are the conclusions of Schwartze* and Tröltsch†, two of the most careful and reliable observers, that "among the many reports of favorable results from this operation, none of them can be said to give any sufficient evidence of its real value [of course Von Tröltsch is now speaking of the paracentesis performed in cases of chronic catarrh and not of those where it has been done, as in the opening of an abscess], unless the patients have remained for a long time under observation after the operation. Most of the histories are in this respect imperfect." Schwartze says "that, up to the present time, it is only in very rare cases a permanent success has been seen by trustworthy observers." Mr. James Hinton‡ reports of seven cases for the most part very favorably. Five in 1870, three of which were very successful, would throw some doubts upon the conclusion arrived at by Schwartze, who only operated upon eight cases of chronic catarrh; he also states in his pamphlet, that the operation is useful in a limited number of chronic cases. Mr. Hinton, as far as the author can judge, is perfectly honest and willing to relate his failures, as on p. 227: "Since most of the cases I have referred to have been successful ones, I think it is better briefly to relate one in which I was entirely unsuccessful. Such cases, no doubt, will continue to occur, but I believe that a good diagnosis, such a one as we may very reasonably hope to attain, will reduce them to an exceedingly small percentage." We shall give an abstract of three successful cases:

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* Die Paracentese des Trommelfells, von Dr. H. Schwartze. Halle, 1868.

† Treatise on the Diseases of the Ear. Translated by Dr. Roosa, New York, 1869.

‡ Guy's Hospital Reports, 1869–70.

"CASE I. *Deafness, with recurrent attacks of inflammation in each tympanum, following scarlatina six years previously; evacuation of small dense masses of mucus by incision.*—May 14th, 1868. M. G., aged twelve, a healthy boy; at age of six had scarlatina, followed by discharge from right ear only, lasting about fourteen days. Ever since he had been decidedly deaf in the right ear, and with the exception of two years, had been more or less so in the left, and subject also to frequent attacks of pain, during which any sound, as music, etc., became painful. Watch* was heard on contact on right side, and one inch on the left; the tuning-fork was heard well upon the vertex, louder in the better ear. Each membrane appeared very concave; there existed also a small white *dimple* anteriorly, apparently a healed perforation. The throat was pale. He could not inflate the tympanum. Air was blown through the Eustachian tube when he swallowed, without much difficulty, entering the tympanum with a sharp sound, and improving the hearing on the right side to three inches, and on the left to twenty-four, the membranes appearing afterwards convex posteriorly. Tincture of chloride of iron, sol. iodine, salt, and water to be drawn through the nose.

"Jan. 24th, 1869. The right ear has remained very deaf, and lately been subject to pain in the left ear for three or four days, attended with discharge. In a week, by treatment, the redness and pain were gone; watch heard each side at fourteen inches. I had formed, however, the decided opinion that the continued liability to pain and deafness depended upon the presence of retained secretion in the tympanum, and that its removal afforded the only prospect of permanent benefit. I made the usual incision in the right membrane, viz., between the position of the malleus and incus, and extending from within half a line of the upper to within a line and a half of the lower border of the membrane. I then, after passing air through the Eustachian tube, injected through it, by means of the catheter attached to an elastic bag, a solution of bicarbonate of soda (grs. xx to f℥i). The effect produced by this was that there protruded from the incision a white shining mass of mucus. For the next four days the injections of air and solution of soda through the Eustachian tube were repeated, and with the effect of washing out through the perforation small dense masses of white mucus; on the fifth day the incision was healed. The same treatment was then adopted for the left ear, and with very similar results. The improvement of hearing on each side was decided, but not complete; accordingly the incision was repeated, and with precisely similar results,—the gradual forcing out of small dense masses of mucus; twice more on each side. No irritation whatever followed, and the hearing of both ears became, so far as I could judge, absolutely perfect, the lowest whisper being heard at the distance of six yards. The right ear, which had been continuously deaf for six years, appears to have recovered as completely as the left."

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* The hearing distance of Mr. Hinton's watch is not stated. The late Mr. Toynbee's was three feet. Some must employ a watch with a much louder tick; hence the variety in the results.

Mr. Hinton believes that relaxation of the membrana tympani, accompanied with thinning of its substance, is a very frequent effect of the protracted presence of mucus within the tympanum, and that when mucus is present within the tympanum, the membrane is more depressed, at least in parts, than protruding outward. He has also known of alternate healing and giving way of the membrane in which mucus had accumulated. On this ground he has adopted the practice of treating all perforations of the membrane, acute as well as chronic (unless particular conditions forbid it), by washing out the tympanum with a warm solution of bicarbonate of soda and chlorate of potash, syringed freely through the perforation. This is done by means of the Eustachian catheter, but in the opposite direction, by applying the syringe to the meatus, the nozzle being well covered with elastic tubing, so as to fit pretty closely without causing pain; the stream may be sent with considerable force, provided the Eustachian tube be open, and will escape by the nostril, the head, of course, being bent forward. This cleansing should be repeated every second or third day until all appearance of an accumulation has ceased, and then a solution of sulphate of zinc (grs. ij–x add f℥i of water) may be substituted and used in the same way.

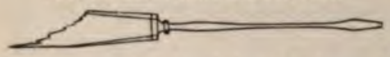
Case II.—This is an instance in which, after perforation, masses of mucus were syringed out with good results. Among the complications which Mr. Hinton notices, is a frequent obstruction of the Eustachian tube. This is for the most part dependent upon the swelling of the mucous lining, and an inspissated secretion; this is sufficiently treated by inflation during the act of swallowing, and by the passage of alkaline and astringent fluids employed to wash out the cavity of tympanum. This is by no means always successful in relieving the case; sometimes the constriction is of the most obstinate character, and requires for its removal vigorous and persevering treatment,—by the introduction of bougies of laminaria or very small elastic tubes passed through the Eustachian catheter and along as far as possible; air or fluid being then injected through them so as to exert a direct pressure upon the constricted part.

He then records Case III., in which mucus accumulation took place in each tympanum. On the right side deafness existed since childhood, with obstruction of the Eustachian tube. Three times the incision was repeated; also the treatment by bougies, with perfect recovery. The only unpleasant result after the introduction of a laminaria bougie was, that the air escaped into the cellular tissue, causing some swelling of the soft palate and uvula.

These were pricked by the point of a knife, and pressure made, and in two days all swelling had subsided. The treatment, however, was omitted for three weeks, and then resumed by the injection of a solution of carbonate of potash.

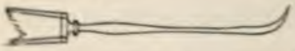
He began in August, 1868, and it was not until February 2d, 1869, that a small stream of air entered the tympanum; but on the following day the tube closed again, and this continued for some weeks. On the 9th of March the membrane was incised for the last time, and a yellow viscid matter was washed out; but it was not until April 16th that the tendency of the tube to close was overcome. On that day he syringed into the tympanum a solution of the nitrate of silver (grs. v ad. f℥j), and from that time inflation was easy. The watch was heard at forty inches, and a low whisper at six yards.

Fig. 66.—INSTRUMENT FOR PUNCTURING MEMBRANA TYMPANI.



The author has resorted to the operation in chronic cases of catarrh of the tympanum in several instances, but, so far, his success has not been what he could have wished. When it is desirable to make a simple puncture, the instrument Fig. 66 was employed; but if a portion of the membrana tympani was to be removed, or a large incision made, he used the sickle-shaped instrument, Fig. 67. The operation in some cases is attended with considerable pain; to allay this, and the nervous feeling attending the dread of the operation, it is well to administer the nitrous oxide gas, or a mixture of sulphuric ether and chloroform, so as to produce a gentle sleep.

Fig. 67.—INSTRUMENT FOR INCISING THE MEMBRANA TYMPANI.



ACCUMULATION OF SERUM IN THE TYMPANIC CAVITY.

In the valuable monograph of Politzer on the membrana tympani, in "Health and Disease," the translators* have added a supplement from him, of the diagnosis and treatment of the accumulation of a fluid resembling serum, in the tympanic cavity, but not involving the transparency of the membrana tympani; that it admits light enough into the cavity so that this fluid can be seen, being of a dark-gray color on the membrana tympani. The boundary between the parts is marked by a fine black line, having the appearance of a black hair lying upon the membrane. By causing the patient to lie down, the black line changes its position, showing it is fluid. When air was forced through the Eustachian tube by Politzer's method, and the membrana tympani inspected, the following changes occurred: the lateral portions of the membrane bulged out, and instead of the distinct limitation in the colors before described, the whole field was covered with rings (or air-bubbles in the fluid),* of various sizes, having dark contours. The other symptoms were deafness, heaviness, and pressure in the head, with loud ringing.

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* Translated by A. Matthewson, M.D., and H. G. Newton, M.D., New York. William Wood & Co., New York, 1869. Pp. 161–169.

The treatment in the majority of Dr. Politzer's cases consisted in the employment of his method for inflating the middle ear, with the head bent over to the opposite side, and somewhat forward. In the cases in which the membrane was much shrunken, and presented a dark greenish-yellow color, Dr. Politzer, after using the air douche with only temporary success, performed paracentesis, and immediately afterwards forced air through the ear by his method, thus driving the matter out into the external meatus.

The late Mr. Toynbee discovered, in a post-mortem examination, the first indication of serum with or without mucus or lymph. Voltolini† followed Toynbee, more especially in his inaugural essay (Examination of the Ear in the Cadaver: Breslau, 1862), by describing the peculiar characteristics of the mucous membrane of the tympanum as those of a serous membrane. Politzer, again treating of this subject (1869), after numerous observations, mentions a new characteristic, that, partly from the deflection of the rays of light reflected from the promontory, and partly from the yellowish color of the fluid in the tympanum, the gray color of the membrane is often tinted a light bottle-green.

Some of the patients had the sensation of the movement of a fluid in the middle ear when the head was inclined backward, or sideways. This symptom was noticed

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ch was the first to recognize, by inspection, the presence of in the tympanic cavity, in 1862.

cumulations in the Tympanum: Archives of Ophthalmology y Professors Knapp & Moos, vol. i. No. 2, p. 557. New York, Co., 1870.

in a case under the writer's care, and was relieved by Politzer's method.

During an interview between Dr. Moos and Politzer, in 1869, the latter mentioned a still more characteristic symptom,—the decided improvement in hearing following the use of the air douche; which, however, generally sank to the original minimum in a very short time, especially when the air douche was not regularly continued. Dr. Moos* has had the opportunity of observing seven cases of serous exudation into the tympanum. Five of these were on both sides, and four were relapsing. The following is an abstract of these interesting cases:

Case I.—The result of a wound. Paracentesis on both sides; relapse; final recovery. Duration of treatment, 3d of May to the 22d of August.

Case II.—Serous accumulation in the left tympanic cavity, affording no indication on the tympanic membrane; paracentesis but once performed; permanent recovery. Duration of treatment, May 10th to September 5th.

Case III.—Serous accumulation in the tympanic cavity on both sides; paracentesis on both sides; repeated on the right; otorrhœa of short duration; formation of furuncles in both external ears; recovery. Duration of treatment, 20th of March to the 28th of April. Hearing distance not given at the termination of treatment. Watch employed—normal hearing distance thirty feet. This patient only heard it at nine inches. This case is somewhat remarkable as being from Philadelphia.

Case IV.—Serous accumulation in the right tympanic cavity; small quantity of serum; the demarkation indicated by two divergent descending lines; paracentesis; subsequent otitis media and formation of furuncles in external meatus. Duration of treatment, 1st of June to June 12th. Hearing distance of watch prior to treatment, one foot; after, two feet.

Case V.—Serous accumulation in the tympanic cavity on both sides; paracentesis on both sides; hearing restored; continuance of subjective noises on the left side. Hearing distance at the commencement of treatment,—right side, six inches

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* Archives of Ophthalmology and Otology, op. cit., pp. 557–602.

(in place of six feet); left side, with the watch, one foot (in place of thirty feet); voice, at a distance of six paces. Duration of treatment, May 25th to the 11th of June. The patient had the normal degree of hearing in the right, and four inches in the left.

CASE VI.—Serous accumulation in the tympanic cavity on both sides; absence of the characteristic appearance of the membrana tympani; paracentesis and relapse on both sides, followed by the first appearance of characteristic symptoms on the left side; repetition of the paracentesis on both sides; repeated myringitis, resulting from operation on the right side. Duration of treatment, from 8th of June to July 14th. Hearing distance prior to operation,—right ear, five inches; left ear, seven inches. After July 14th, hearing distance six inches. Perforation remains.

CASE VII.—Rapid accumulation of serum in both tympanic cavities; paracentesis on both sides; sudden restoration of hearing. Duration of treatment not given. Hearing distance prior to treatment, one and a half inches; after air douche, at eighteen inches. The hearing distance reached four feet.

"*Remarks.*—With the exception of a boy nine years of age, all the subjects were adult males.

"The conjectural duration of the disease extended from four days to three weeks.

"The immediate cause could be determined in one case only,—a draught of air upon the head when perspiring.

"In the remaining cases the affection must be considered a secondary one, an extension of the catarrhal inflammation from the nares and pharynx to the Eustachian tube.

"Continuous subjective noises were present in four cases; interrupted in two cases,—in one so severe that the continued singing had a disturbing effect upon the mental action of the patient.

"In the majority of the cases these noises were removed by the introductory treatment. In one case they disappeared entirely only after a long course of treatment following paracentesis; in another case they persisted, and made an unfavorable symptom for the prognosis. Where they had once existed, and been dispelled by treatment, they returned on the occurrence of a relapse, and remained, as a rule, during its whole course. Vertigo was present in two cases; in one of these it continued after paracentesis had been performed, and was probably owing to gastric trouble.

"During the time immediately following the paracentesis, we should not omit to make the patient remain in bed, or keep his room, at least until the perforation has closed, and in unfavorable weather, under all circumstances. Early treatment of the pharynx and nasal passages is necessary.

"On the whole, the results are so favorable, and the cure so often permanent, that the treatment of serous accumulations in the tympanum (middle cavity of the ear) may be numbered among the most satisfactory in aural surgery."

NEW METHOD OF PREVENTING THE CLOSURE OF AN ARTIFICIAL PERFORATED MEMBRANA TYMPANI.

The following case is worthy of notice, from the success of a new method of treatment employed by Politzer to prevent the artificial perforation of the membrana tympani closing:*

"On the 22d of October, 1868, Anna P., aged forty-eight, a native of Vienna, first presented herself at Politzer's clinique. Two years before, according to her account, she was suddenly seized with severe pain in the left ear; the pain lasted for eight days, and was followed by a copious secretion. This also ceased in a few days, but deafness, and the passage of air through the meatus on blowing the nose, continued for some weeks. An application to the meatus, ordered by a physician, did much to diminish the secretion, and decidedly improved the hearing; this improvement lasted but about two months, and at the end of that time she began to experience troublesome sensations in the ear, such as loud ringing and rushing sounds.

"A marked degree of deafness was observed at the date of admission; this had lasted for a year.

"The trouble in the right ear dated from three months before admission; it commenced in the same manner as in the left ear; the pain continued, notwithstanding the appearance of a purulent secretion on the first day, for a period of three weeks. The secretion and the sensation of a hissing sound in the ear were still present upon admission.

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* Clinique in Aural Surgery, observed and reported by C. J. Blake, M D., Boston Medical and Surgical Journal.

"On examination, the left membrana tympani appeared of a dull-gray color, the short process of the malleus and the folds running outward from it were very sharply marked, and the manubrium mallei drawn inward and less clearly defined than usual; below the manubrium was a dark and depressed spot of an oval form, about 1‴ long by ½‴ wide, which was recognized as the cicatrix of a previously existing perforation. The ticking of a watch could be heard only when the watch was brought in contact with the ear, or when it was pressed upon the side of the head; and the voice at no greater distance than 3′. After the injection of air into the Eustachian tube by Politzer's method, the cicatrix was seen to have been forced outward and the distance at which the voice was heard was increased by one foot, but it was still necessary to bring the watch in contact with the ear. In the right membrana tympani, situated below and anteriorly to the manubrium mallei, was a circular perforation of the size of a pin's head, through which a drop of thick pus and a few air-bubbles were forced by the employment of Valsalva's method. After removal of the pus, the watch was heard at a distance of 2″, and when pressed upon the head in front of the ear; the voice at a distance of five feet. The tuning-fork, placed over the sagittal suture, was most clearly heard in the left ear, because the obstructions to the passage of vibrations from without retained those which were communicated to the tympanic cavity through the medium of the bones of the head. The results of the examination showed the existence of purulent catarrh of the tympanic cavity of the right ear, with perforation of the membrana tympani. The same process had existed in the left ear, but the purulent secretion from the mucous membrane of the tympanic cavity had ceased more than a year previously, and the perforation in the membrana tympani had been closed by a cicatricial tissue. The fact that a decided improvement in hearing followed the injection of air, favored the supposition that the deafness resulted neither from closure of the Eustachian tube nor from a collection of mucus in the tympanic cavity, but from (old) adhesions between the ossicles and the tympanic walls.

"The previous history showed that as long as the patient was able to force air outward through the meatus, that is to say, as long as the perforation existed, the loss of hearing on this side was but slight, whereas the closure of the opening was followed by decided deafness. These facts justified the conclusion that either the malleus or incus was attached to the wall of the tympanic cavity by firm bands of connective tissue. So long as the perforation in the membrana tympani existed, the vibrations could pass through it, and, striking upon the base of the stapes, be communicated to the labyrinth. After the closure of the opening, the vibrations impinging upon the membrana tympani were no longer communicated to the stapes, because of the resistance of the malleus and incus. The indication for treatment in this case was the removal of the thin cicatrix, in order that vibrations might be admitted to the tympanic cavity through the perforation.

"The excision of a portion of the membrana tympani in certain cases of disease of the ear was first recommended by Riolan, in the seventeenth century; but from the doubtful results of the operation, very little regard was paid to it by the more celebrated surgeons of the time. The first and most important scientific communications concerning the artificial perforation of the membrana tympani date from the beginning of the present century, when Sir Astley Cooper and Himly, simultaneously and independently of each other, reintroduced, and, encouraged by the favorable results at first obtained, strongly recommended it. They became convinced, after long trial, of the difficulty of making the artificial opening a permanent one, and finally abandoned the attempt; but in the mean time their favorable reports having reached the continent, the operation was performed in both France and Germany on hundreds of cases, in almost every one of which, however, the first gain proved to be but temporary, for sooner or later the opening became closed by cicatricial tissue.* Pieces of catgut cord, splinters of whalebone, etc.

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* Schwartze. Studien und Beobachtungen über die Künstl. Die Paracentese des Trommel-fells. Archiv für Ohrenheilkunde. 2 Bd.

were introduced, and the edges of the perforation touched with caustics, but without favorable result. Bonnafont,* in one case, introduced a silver canula, and allowed it to remain forty-five days, but the closure of the perforation followed its removal. Many instruments have been devised for the purpose of removing a portion of the membrana tympani. Among the latest are those of Wilde, Toynbee, and Gruber; but none of them has succeeded in gaining a decidedly favorable result. The operation proposed by Menière, of perforating the membrana tympani by means of caustics, seems to have been equally unsuccessful; and concerning sphyrotomy,† we have as yet no definite reports of success. The indications for the operation in the present case induced Dr. Politzer to make the attempt of establishing a permanent artificial perforation by means of a new method; and on October 26th, he operated as follows: a large-sized aural speculum having been introduced, and the membrana tympani illuminated by means of a reflector, an incision was made with a paracentesis knife through the cicatrix parallel to its long diameter, and a 'laminaria-stäbchen'‡ introduced, and allowed to remain for two or three hours, by which time it had sufficiently expanded. Its removal showed a circular opening in the membrana tympani, through which a hard rubber eyelet, having several rims, was pushed into the tympanic cavity to the depth of ½'''. The pain resulting from the operation was very slight. Through the opening of the eyelet, the mucous membrane covering the promontory, of a light reddish-yellow color, could be plainly seen; and the patient voluntarily declared not only that she heard better, but that the sensation of noises in the ear had very much diminished. It having been ascertained that the eyelet was firmly fixed, the edge of the perforation having slipped into one of the grooves between the rim, the hearing power was now carefully tested, and the watch, which it had been necessary before the operation to bring in contact with the ear, was now heard at a distance of 9″, and the voice at a distance of forty feet, instead of three feet.

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* Traité théorique et pratique des Maladies de l'Oreille. Paris, 1860.

† Sphyrotomy, the operation of excising the handle of the malleus; myringo-dectomy being the excision of a portion of the membrana tympani. Both these means are employed as remedies for impairment of hearing and *tinnitus aurium;* the first was proposed by Dr. Warden of St. Petersburg, and the latter by Prof. Joseph Gruber of Vienna.

‡ Laminaria, a species of alga, possessing the expansive properties of pressed sponge, and employed for the same purpose.

"On the 10th of February, Dr. Blake had opportunity of examining the case above described. The eyelet, which is about the diameter of a common steel knitting-needle, projects two lines or more from the membrana tympani, and rests upon the posterior inferior wall of the meatus; it is closely encircled, and firmly held in place by the edges of the perforation. The patient does not notice its presence in the least, and is entirely relieved from the previous unpleasant sensations in the ear. The ticking of a watch is heard at the distance of 14″, and words spoken in the ordinary tone of voice, throughout the length of Oppolzer's ward, a distance of about ninety feet.

"The right ear having been treated with inflation, Politzer's method, and the application of pulv. aluminis, the purulent exudation ceased, and the perforation became closed by cicatricial tissue about four weeks since. On examination, the cicatrix, 2‴ in diameter, is readily seen, and the hearing power is normal. In this ear, the disease having been treated in season, the ossicles retain their normal relations to each other, and to the walls of the tympanic cavity.

"The eyelets (made by Leiter of Vienna) are of hard rubber, and from 1‴ to 1½‴ in length; the longitudinal opening is oval in form, and about ½‴ in its longest diameter. On the outer surface are either one (Fig. 68) or two (Fig. 69) grooves. In the outer end is a small transverse opening for the passage of a silk thread, by which the eyelet can be withdrawn in case of its slipping from the pincette during the operation.

Fig. 68.

Fig. 69.

"The pincette used in introducing the eyelet terminates in two sharp points, which being inserted in the longitudinal opening, and then expanded, give a much firmer hold than if the eyelet were grasped from the outside."

CHAPTER XIV.

ON THE MECHANICAL APPLIANCES USED IN THE DIAGNOSIS AND TREATMENT OF AFFECTIONS OF THE EUSTACHIAN TUBE AND MIDDLE EAR.

THE intimate connection between the throat and the middle ear, the mucous structures of which are continuous through the Eustachian tube, and the knowledge that many aural affections are extensions of pharyngeal disease, have directed a great deal of attention to the means of gaining access from the pharynx to the middle ear, and given rise to the introduction of numerous ingeniously devised instruments for facilitating the purpose.

Some of these we have already noticed, and we will now describe the most important and practically useful of these appliances, and the manner of their employment.

And first we will describe the rhinoscopic mirror, a small piece of looking-glass or polished metal firmly attached to a convenient handle, at such an angle that when carried behind the soft palate it will receive the image of the tissues in front of it above, and to either side, according as it is inclined more to the right or to the left, forward or backward. (See Fig. 70.) The employment of the rhinal or pharyngeal mirror enables us to inspect the condition of the pharyngeal portion of the Eustachian tube and the parts adjacent. Such an examination should never be neglected in cases of disease of the middle ear, and should always precede, if possible, the use of the Eustachian catheter, as it enables us to recognize the position of the entrance of the tube, so that we may then reach it at once, instead of searching for it, as we too frequently do.

The examination of the upper region of the pharynx is by no means an easy one at all times, and cases will be met where it seems impossible to make a satisfactory exploration.

The value of the method is so great, however, that it must become incorporated into the regular manipulation of the aurist, or he will have the mortification of being unable to accomplish results equal to those attained by his competitors.

Fig. 70.

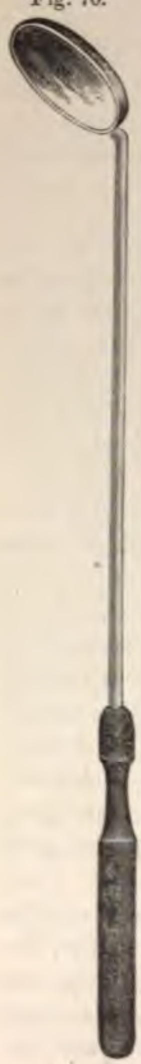
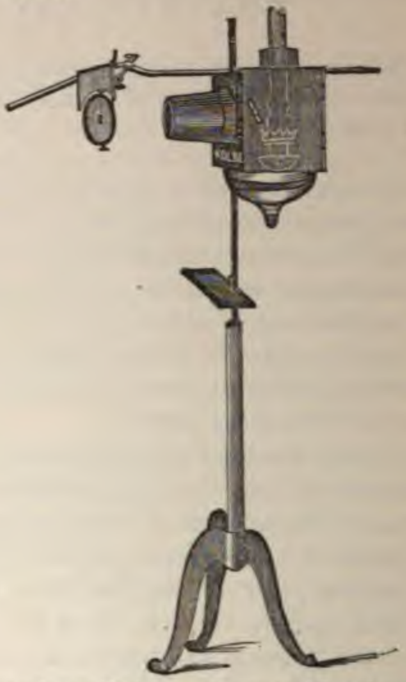


Fig. 71. — THE ILLUMINATING APPARATUS OF LEWIN, WITH AN AUTO-LARYNGOSCOPIC MIRROR.



Rhinoscopy requires, in the first place, a good light. We will suppose the day to be a fine one and the sun to be shining into the examining-chamber. The patient is to be placed, sitting or standing, as may be most convenient, so that the light shall fall directly into the open mouth, and illuminate the fauces. The operator takes a position in front of the patient, but in such manner that his hand shall not cast a shadow into the throat, and proceeds with the examination in the manner to be described presently. If the light is unfavorable for a direct illumination in this way, it may be reflected into the mouth from a small looking-glass, so placed as to receive the direct rays from the sun and deflect them into the mouth. This reflector may be placed on the window-sill, and throw the light upon the opposite wall in such manner that when the patient is seated with his back to the wall the rays fall at once into his mouth.

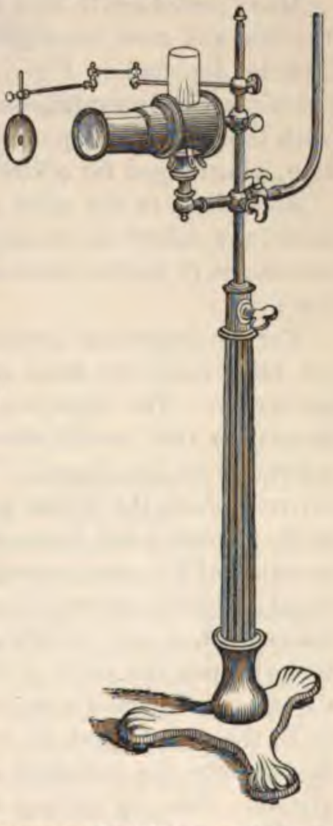


Fig. 72.—Tobold's Illuminating Apparatus.

Another plan of using reflected light is to condense some of the diffused light of the apartment upon a concave mirror, and thence reflect it into the throat. This is the manner most frequently employed; and the reflector may be attached by a universal joint to a band encircling the forehead of the operator, or it may be attached to a stand or placed upon a table.

So rarely do we have the opportunity of making these examinations by sunlight that we prefer the use of artificial light, and we may use gas or coal oil, as in Fig. 71, the latter of which furnishes the brighter, whiter, and more constant flame. Some practitioners have arranged an oxyhydrogen light* for this purpose. Gas will be found sufficiently available for all ordinary and almost all extraordinary cases.

Direct illumination by artificial light is rarely employed in these examinations. The process consists in placing a condensing lens before the light, the rays of which are thrown directly into the mouth of the patient. The light is between the operator and the patient; and the instruments are carried to one side or other of the light. The eyes of the operator are shielded from the direct rays of the light by a screen passed around the chimney of the lamp.

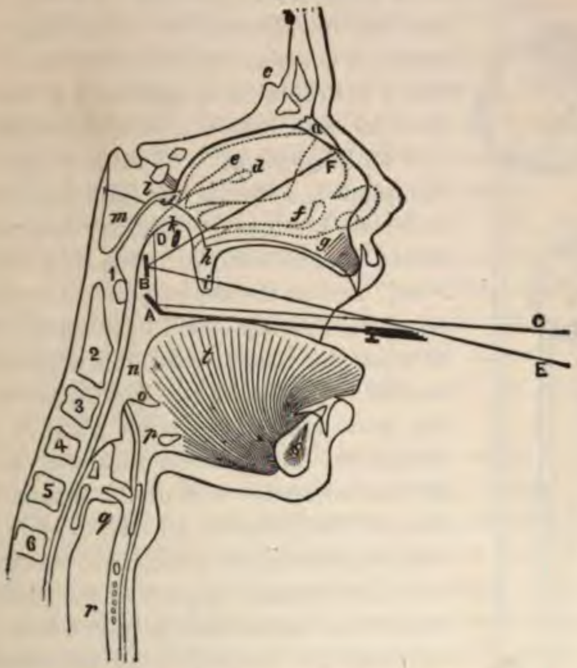
Reflected artificial light, however, is the method which will be found most convenient. Here the light from a lamp is received upon a concave reflector, as in the examination by diffused sunlight. The mere light of the lamp received upon the reflector is not sufficient to answer every indication; and although there are many cases in which this will be all that is required, it will be better to employ light which has been condensed before it is received upon the reflector.

Many instruments have been devised for this purpose, but the best and most convenient one will be found to be that of Tobold, depicted in Fig. 72, attached to a convenient stand, permitting of instantaneous movement in any direction, and with the reflecting apparatus above the source of illumination, as arranged for office work, by Dr. Cohen of this city.

According to the plan advised and practiced by Semeleder, the mirror is connected with the frame of a pair of spectacles in such a manner as to support it steadily before the eye.

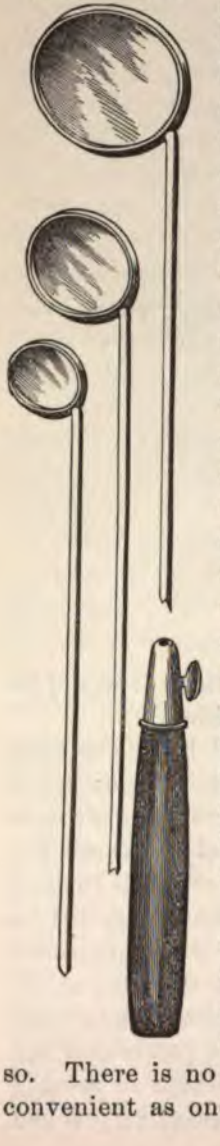
For the purpose of conducting a rhinoscopic examination we need much the same apparatus as for laryngoscopic examination. The light is to be thrown rather lower in the fauces, so that it will shine brightly on the spot where the mirror is to be placed. The desired object is to place a mirror behind the uvula and soft palate, with its reflecting surface upward and forward, so as to illuminate the posterior entrance of the nasal passages and the parts in the immediate neighborhood, as may be seen in Fig. 73, A; by this arrangement, a ray of light, C, striking upon the mirror is thrown upon the vault of the pharynx at D. By still further depressing the handle and raising the mirror to the position in B, the ray of light, E, impinging upon the mirror, is reflected into the posterior nares at F, which point becomes visible. Now, by sliding or inclining laterally the mirror, the Eustachian orifices are shown at k, with sinus of Rosenmüller and the lateral pharyngeal walls. The primary requisite to successful examination is, that there should exist space enough between the velum and the posterior wall of the pharynx to admit the mirror. Sometimes the hard palate extends so far back that there appears to be but a rudimentary soft palate. Under such circumstances it would be impossible to make an examination of this kind.

Fig. 73.



It is essential that the soft palate should hang free from the posterior wall of the pharynx. Now, when the mouth is kept open for purposes of examination, there is an involuntary disposition to breathe through it, instead of through the nostrils as is ordinarily the case. The moment air is inhaled through the mouth, the palate becomes closely applied to the posterior wall of the pharynx, and thus the communication between the nares and the mouth is completely cut off. It is, therefore, necessary that means be adopted to secure the preservation of sufficient space between the palate and the pharynx; and this is to be done by the attempt to breathe through the nostrils while the mouth is kept open. When the respiratory current is received through the nostrils, the palate of necessity becomes relaxed and removed from the pharynx, and the desired space is gained. This action of the palate is readily studied by observing it in a mirror. It is often difficult for the patient to succeed in breathing quietly through the nostrils with the mouth open; but a little practice, especially if the attention be called to the effect as watched in the looking-glass, will almost always accomplish the result. Should this plan not succeed, he may be told to emit what are called "nasal sounds," such as the French "en," and as the expired air passes through the nares the object will be attained. Should this fail, we resort to forcible separation by means of a broad blunt hook passed under the parts and then drawn forward by the examiner. This plan is often only partially successful on account of the spasmodic action of the palatine muscles which follows the procedure, and which is to be overcome only by repeated contact of the instrument until its presence and pressure is tolerated, or until the irritability of the muscles is exhausted. The same amount of time and patience devoted to the acquisition of the required mode of breathing will insure the success of the latter and more desirable method of securing space enough between the pharynx and the palate for the introduction of a mirror.

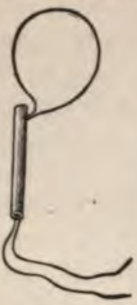
Fig. 74. — RHINOSCOPIC MIRRORS.



The mirrors to be used may be the same as employed for examination of the larynx, or like those at Fig. 74. The majority of authors insist that the mirror must be attached to its stem at a right angle or nearly so. There is no necessity for this, nor is such a mirror as convenient as one of the ordinary laryngeal mirrors. Another point insisted upon is that the mirror shall be about half an inch or so in diameter. There is no reason for employing so small a mirror; for greater convenience, we ought to have a series of mirrors of different sizes, as seen in Fig. 74, unless for exceptional cases. An ordinary laryngeal mirror of the diameter of seven-eighths of an inch or an inch will usually answer; but we occasionally encounter cases where a mirror of an inch and a quarter in diameter can be employed with the greatest freedom. It is only where but little space exists between the palate and the pharynx that small mirrors are needed; and in such cases, of course, mirrors of three-quarters, five-eighths, or half an inch are required; but such cases are the exception, and not the rule. That the distance to the posterior wall of the pharynx is greater than would at first sight be supposed, may be readily proved by taking a pencil or any similar object and passing it into the mouth until its extremity reaches the pharynx.

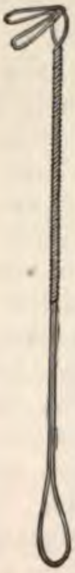
A mirror soldered to the shank at a right angle is of most use when the head is decidedly inclined forward, as has been recommended by some observers, who contend that the palate thus drops somewhat forward of its own accord. This is not often the case. If the head is kept erect, as it should be, and a mirror at a right angle to the shank is used, the hand of the examiner is much more apt to be in his own way than if the mirror is used at an obtuse angle; and if a vertical position of the reflecting surface of the mirror is desired, it is readily produced by lowering the handle, which at the same time lowers the hand, so that it is still less likely to intercept the light. On the other hand, when the object is to gain a view of the upper portion of the posterior nares, as it is called, or the vault of the pharynx, in a mirror at a right angle to its shank, the handle will have to be raised so that the mirror may not thus intercept vision. The ordinary laryngeal mirror is the best for rhinoscopic purposes. It is only a perspective image of the parts in front and above it that can be procured at best, and is easier of manipulation and more suited to examination of all parts than the mirror usually recommended.

Fig. 75.—Türck's Palate Noose.



It has been thought desirable, as a rule, to resort to mechanical means for raising the uvula and pulling it with the palate forward, in order to facilitate examination and increase the naso-pharyngeal space. For this purpose a flat hook about three-tenths of an inch broad, and made of silver or other metal, is used. This hook, fenestrated or not, according to fancy, and having a turn-up edge of one to two-tenths of an inch, is passed beneath the uvula, which is received upon its broad surface and hooked under the velum, which is then gently drawn upward and forward. Sometimes the palate is seized between the broad lips of forceps, fashioned like the palate hook.

Fig. 76.—Wales's Palate Hook.



I find but few patients who can bear these instruments without some little training, and I have discarded their use except in cases where the uvula is very long and thus obstructs the image, or in certain cases of pathological alterations, where I wish to examine everything with extraordinary minuteness.

Türck proposed to remove these difficulties by adopting the use of the little contrivance shown in cut (Fig. 75), consisting of a small silver tube, about an inch long, perforated near one extremity by a small hole, and of sufficient diameter to permit the passage of a doubled thread, the "bight" of which is drawn through the small hole at one end of the tube, while the free ends depend from the other. In employing this noose, the loop of the thread is hitched over the uvula, the tube is then shoved down upon it, and the free extremities of the thread are drawn forward from the mouth until sufficient traction is made, upon the velum, when they are to be attached to a band passing around the head.

Neither of these plans has succeeded in accomplishing the object in view, and indeed, from the irritability of the points about the throat, it is difficult to devise any instrument that will possess, in its application, advantages more than counterbalancing its inconvenience. Dr. Wales has found, in the little hook shown in Fig. 76, all the advantages procurable from such an instrument. We have not employed this palate hook, so that we cannot give an opinion in regard to it. It is made of light German-silver wire in the form shown. The points of the hook are intended to catch on the posterior surface of the velum on either side of the uvula, the latter fleshy process being sustained in the small circular bend of wire at the base projecting horizontally, and doubled, as it were, out of the way upon the anterior surface of the velum. The hook allows of the most thorough examination of the posterior surface of the soft palate, as the fine wire covers but little of the surface. The handle of the hook is shaped into an oval, with which the elongated uvula may be removed to one side or the other, as circumstances require, and held against the palate. The wire permits the hook to be bent into any desirable shape; for instance, if the surgeon wishes to use the hand holding the hook for some other purpose, he has only to expand the two wires, forming the handle into an oval, and bend this over the nose, when the palate will be securely held forward. This plan, of course, will be restricted to complex and difficult cases of rhinoscopic manipulation.*

If an elongated uvula prevents examination, the best procedure for the patient's ultimate benefit is to retrench it. If any form of palate hook is employed, it must first be warmed, on the same principle upon which we warm a catheter before introducing it into the urethra.

Now, if the observer employ a palate hook with one hand and a mirror with another, how shall he introduce the catheter, should such procedure be necessary? To assist manipulation, therefore, with the palate hook in position, methods have been devised by Kramer, Wagner, and others, by which the end of the palate hook shall rest upon a contrivance suspended from a band encircling the head, or a clamp spanning the bridge of the nose, as in Fig. 77. These inelegant contrivances are said to be tolerably well borne. I have never had occasion to resort to them.

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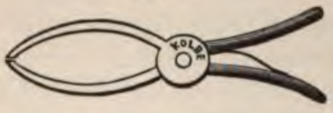
* Medical and Surgical Reporter, p. 125, July 2, 1870.

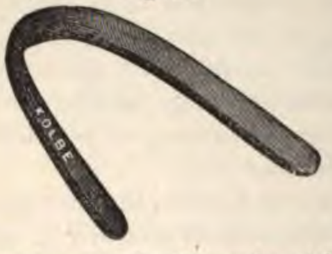
Fig. 77.



The space between the velum and pharynx may be gradually enlarged to some extent by successive drawings forward of the velum, by means of a broad blunt hook, and repeated at intervals for several days or weeks.

An appliance all but absolutely necessary for successful examination, however, is a tongue depressor. In examinations, I very rarely resort to an instrument of this kind, letting the patient hold the tip of the tongue with a napkin as far out as possible; but in examinations of the posterior nasal passages, it facilitates the manœuvre, by securing space between the lower border of the uvula and the tongue for the introduction of the mirror and its subsequent manipulation. A tongue depressor for this purpose should be long enough to extend to the base of the tongue, and should not be fenestrated,—one is represented in Fig. 78. It is made of one piece of hard rubber, and the handle portion is bent under, so that the hand holding it and the hand of the instrument itself need not be in the way. It should be applied so as to depress the base of the tongue and bring it forward, and then it may be confided to the patient himself, so as to leave the operator's hands free for the mirror and palate hook, or mirror and instrument, as the case may be. *Rhinoscopes*—instruments combining mirror and tongue depressor—have been invented by Voltolini, Wagner, Mackenzie, Semiock, and others; but I have had no experience with them, having rarely encountered a case where the reflector and mirror used for laryngeal examinations, with the addition of the tongue depressor, has not enabled me to fulfill every indication of diagnosis or treatment.

Fig. 78.

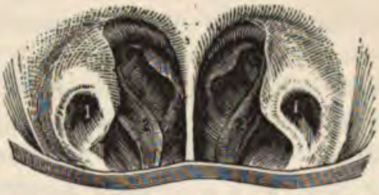


Those portions of structure to examine which we resort to rhinoscopy, are the posterior surface of the uvula and velum; the posterior aspect of the nasal passages, to wit, the septum, turbinated bones, and meatuses; the pharyngeal openings of the Eustachian tubes; the vault or roof of the pharynx; and the upper portion of the posterior and lateral walls of the pharynx. These structures cannot all be examined at the same moment. I have occasionally encountered a case in which I could employ a mirror an inch and a quarter in diameter, and thus see the image of both posterior nares and both Eustachian openings at the same time. Most frequently, however, we can examine but one side at a time, though a little more may be seen in the mirror. The extreme lower portion of the septum and nares being covered by the velum, is not seen; but the upper three-fourths of the space can almost always be examined. The parts are seen more or less in perspective, this effect increasing with the horizontalization of the reflecting surface of the mirror.

If a good view is obtained, we procure such an image as is presented in Fig. 79.

It is very essential to become familiarized with the appearances represented in the rhinoscopic mirror, because this portion of the body is rarely dissected by the student, and the idea of relation of parts, as seen in the skull deprived of soft tissues, is not realized in the examination under consideration. I have known the reflection of a back tooth to be taken for the nares of that side, with the turbinated bones covered with mucus; and the ashy color was not, at first sight, unlike the appearance of the posterior nasal region in a recently boiled skull.

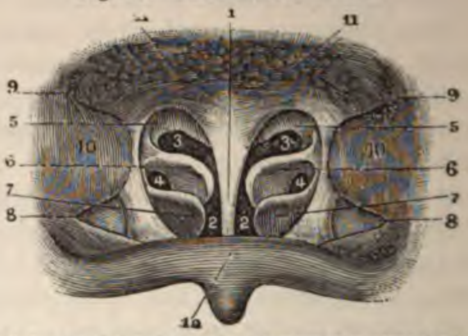
Fig. 79.



1, Eustachian tube, enlarged; 2, the middle turbinated bones.

If we examine the engraving (Fig. 80), we find the prominent object to be a bright columnar ridge in the centre, gradually expanding above. This is the septum narium. It is of a pale-yellow or yellowish-pink color at its narrow portion, but as it expands, it takes the red color of the pharyngeal mucous membrane above. If we follow the outline of the expanding portion of this septum, we define on each side the corresponding posterior nasal opening, the lower portion of which image is cut off by a horizontally-curved projecting red ridge, which, with as much as is reflected below, is the image of the posterior portion of the velum. Following this velum round on either side, we observe it rising over the outer portion of each nasal opening, and then bending sharply over a well-marked protuberance, formed by the internal pterygoid plate of the sphenoid bone, beneath which is the entrance to the pharyngeal orifice of the Eustachian tube. Following this protuberance, we observe it marking a canal with a fossa at its termination as it runs backward, upward, and outward, which is the fossa of Rosenmüller, and lies between this lateral prominence and the posterior wall of the pharynx. In this fossa the Eustachian catheter often becomes engaged during its introduction. To return to the central portion of the image, the parts in shadow each side of the septum represent the free cavity of the nares on each side respectively. Following this shadow from below upward on either side, we see it terminate in a larger shadow, which represents the superior meatus; the bright portion above this is the upper turbinated bone,

Fig. 80.—Rhinoscopic Image.



1, septum; 2, free space of nasal passage; 3, superior meatus; 4, middle meatus; 5, superior turbinated bone; 6, middle do.; 7, inferior do.; 8, position of the opening into the Eustachian tube; 9, fossa of Rosenmüller; 10, lateral wall of pharynx; 11, superior wall of pharynx; 12, posterior surface of velum.

the lower portion of which we see turning down to become lost in a central portion, which is the middle turbinated bone partly covered by another prominent object, which is the image of the inferior turbinated bone, above which, and between it and the middle turbinated bone to the outside, we observe the shadow representing what is seen of the middle meatus. Occasionally we can discern the position of the inferior meatus just below the lower turbinated bone.

Ordinarily we cannot see deeply into the cavity of the nose; sometimes, especially when the mirror is in a vertical plane, and much of it hidden behind the velum, we can see by the side of the middle turbinated bones for a greater or less distance. The color of the mucous membrane of the cavity of the nose is a pale grayish-red or yellow; the space between the outline of the nares and the position of the Eustachian tube is yellowish-red; the opening of the Eustachian tube is red, and the other parts have the usual red color of the mucous membrane of the pharynx. The precise tint of each structure varies with many circumstances, as the position of patient, amount of shadow, and character of the disease.

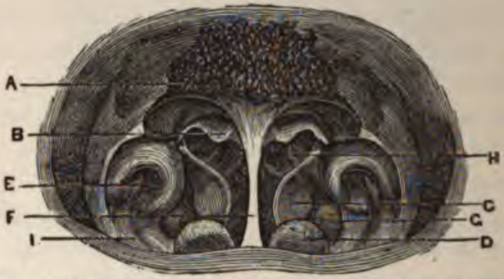
Mucus is easily distinguished, and when present usually hangs about the turbinated bones, the septum, and the Eustachian opening.

In gaining a view of the posterior nares, the first thing seen is the image of the posterior surface of the uvula and palatine arches, which have much the general appearance of the outline of the image afforded by the septum and outline of the nasal openings, and if at the same time the image of a molar tooth is reflected, the deception, to one unfamiliar with the subject, is very great. If, when such an image is obtained, the handle of the mirror is gradually depressed, or the mirror slipped up farther behind the velum, we see the image of the velum gradually extending upward and then backward, not unlike a shelf, on top of which and a little in the rear we begin to recognize the true image of the septum and nares appearing in the mirror.

By turning our mirror a little to one side or the other, we bring the pharyngeal orifice of the Eustachian tube more completely into view. This represents, when seen under favorable circumstances, a projecting nipple, in the centre of which is a distinct depression, the Eustachian orifice. In Fig. 79 is a rhinoscopic view of my own Eustachian tube; and Fig. 81 is that of Dr. Wales, who has kindly permitted me to use it.

We occasionally may succeed in passing the Eustachian catheter with one hand while holding the rhinoscopic mirror in position with the other, and in this way may direct the point of the catheter into the orifice under sight; but cases that can tolerate this double manipulation are rare, and experts who are able to perform it still rarer. Still, the fact that it can be occasionally done is indisputable, and it is therefore well to attempt the manipulation in cases that appear favorable.

Fig. 81.



A, roof of the pharynx; B, superior turbinated bone; C, middle turbinated bone; D, inferior turbinated bone; E, Eustachian tube; F, septum narium.

"Before closing what we have to say on the instruments required in rhinoscopy, it will be proper to call attention to the fact that there is an anterior as well as a posterior rhinoscopy, which in certain cases may be had recourse to with great advantage. Dr. Markusovszki invented a speculum for this purpose, resembling, in its mode of construction, an ear speculum with two compartments; but its size is much greater, and the divisions are larger and flatter. With this instrument, and a concave mirror to illuminate the nasal apertures, Czermak has been able to inspect the inferior turbinate bone and its free border, which passes to the extent of seven-twentieths of an inch above the floor of the nasal fossæ. In one case wherein the nasal cavity was very capacious, he saw up to the posterior part of the pharyngo-nasal cavity, and upon a cadaver he employed a small mirror, its reflecting surface being turned above and in front, and arranged in the space situated under the inferior turbinate bone, in such a manner as allowed a clear view of the nasal orifice of the lachrymal canal, which was marked by a hog's bristle, that had been previously introduced.

"This sort of exploration has hitherto been neglected, as the specula employed have been ill constructed to obtain the desired results. Voltolini employs short polished tubes, ear specula, introduced into the nostrils, and a concave reflector. He has thus succeeded in getting a glimpse of the posterior wall of the pharynx, and the swellings at the mouth of the Eustachian tubes.

"I have employed several sorts of specula, but none seem to me to deserve the same commendation as the one devised by Dr. Thudichum, illustrated in the cut, Figs. 81 and 82.

THUDICHUM'S SPECULUM—FRONT AND PROFILE VIEWS.

Fig. 82.

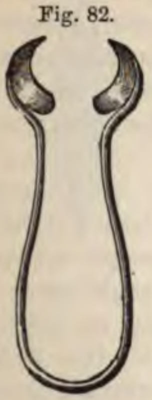
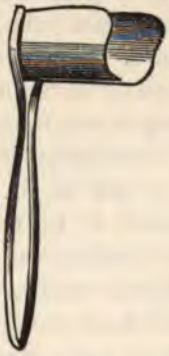


Fig. 83.



He describes it as consisting of two valves held together by a spring, and when compressed, form a canal of oval bore, about three-fourths of an inch in length. The valve which expands the ala is from one-quarter of an inch to three-fifths longer than the valve which is placed against the septum. This latter inner valve should never be long enough to reach the sensitive part of the mucous membrane of the septum. It follows from this that each nostril requires its own speculum. As the nostrils of different persons vary greatly in size, different sizes of specula must be at hand in practice. The speculum is inserted into the nostril while closely compressed; the moment the spring is liberated, the nostril is fully expanded, and if the operator now draws the spring (which serves also as a handle) upward, the cavity of the nose can be fully inspected. The speculum, therefore, is designed exclusively to expand the atrium or membro-cartilaginous part of the nostril; if it were allowed to enter beyond this, and to reach the isthmus formed by the unyielding cartilaginous septum and the nasal margin of the ascending branch of the upper maxillary bone, it would cause pain, and narrow, by its own thickness, this small passage. The new specula cause no pain, widen the aria to the utmost extent, and admit of the introduction through them, into any part of the nose, of instruments for slight, delicate, or severe operations."*

The Eustachian catheter is an instrument of frequent employment, intended to enable us to pass a current of air, of medicated vapor, of steam, of spray, of water, of powder into the Eustachian tube, or through it into the cavity of the tympanum. These instruments are passed either through the mouth or through the nostril, the latter being the method most proper and most used.

The instrument for catheterizing the tube through the mouth is that of Dr. Cutter, of Boston (see Fig. 84), which is intended to be used with the rhinoscopic mirror. The terminal portion can be turned to any angle, so as to meet any desired radius, which may facilitate its introduction. We have made several attempts to employ this instrument, but as they were unsuccessful, we soon reverted to our usual method of catheterizing through the nose.

The catheter generally employed is that of Kramer (see Fig. 85).

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* Med. and Surgical Reporter, op. cit.

Fig. 86 is a small Eustachian catheter for use in young ildren.

Fig. 84.

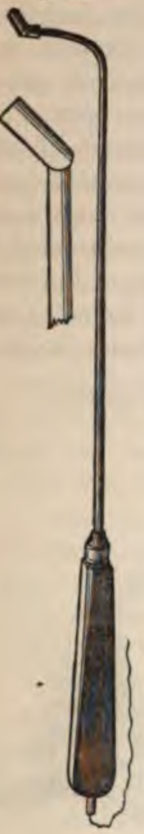


Fig. 85.

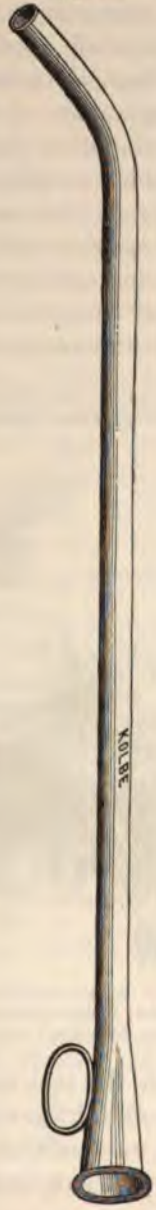
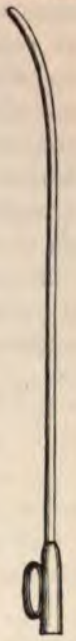
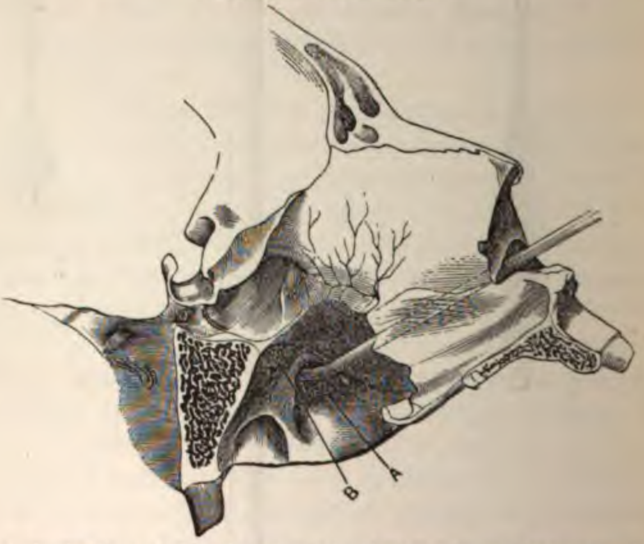


Fig. 86.



The rules laid down by authors for the manner of introducing the Eustachian catheter are very unsatisfactory. The position of the pharyngeal orifice of the tube differs, as can be demonstrated by a rhinoscopic examination, and therefore no one rule is of universal application. Experts in aural surgery, who make themselves familiar by hard study with the anatomical arrangements of the upper portion of the pharynx, are very often able to find the entrance of the tube by a sort of knack which nothing but experience can give. The general practitioner, who has perhaps never seen this portion of the body exposed, for it is rarely dissected in the study of general anatomy, and whose ideas of the relations of the parts are gained from the skull and from engravings, will seldom succeed in the manipulation; hence the discredit which has fallen upon the instrument. The fault is not in the catheter, but too often in the operator.

Fig. 87.—SECTION OF THE HEAD, WITH EUSTACHIAN CATHETER INTRODUCED.

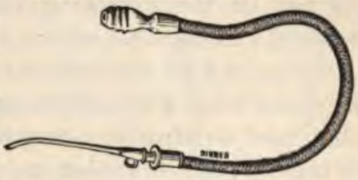


A, showing the turn which the catheter should make in entering the pharyngeal orifice of the Eustachian tube; B, showing the position of Rosenmüller's fossa, and the necessity for withdrawing the catheter before entering the Eustachian tube.

The most popular rule is that of Kramer, to touch the posterior wall of the pharynx, then turn the back of the instrument toward the external auditory orifice and pull it toward you, it will slip over the posterior portion of the cartilage of the tube, and if it is only allowed to ride on the anterior face of this posterior lip of the cartilage, it can then be pushed on into the orifice of the tube, as shown in Fig 87. We prefer to turn the beak of the instrument as soon as we enter the pharynx, to graze the lateral wall with it as we proceed backward, mounting the anterior lip of the tube. In this way we avoid catching the instrument in the fossa of Rosenmüller. If the catheter remains in position, it is probably in the tube. This can often be determined positively by making a rhinoscopic examination, which will show us if it is in the orifice; if not, it will show us the relation the beak of the catheter bears to the orifice, and we can readily make the correction. Where the tube is impervious, so that a current of air cannot be passed into it, this would be almost our only method of verification,—an important point if we wish to force a stylet through the tube.

As an instrument of diagnosis the Eustachian catheter is used to determine the permeability of the Eustachian tube, as in Fig. 88. This is done by blowing into the catheter, producing a certain sensation easily recognized by the patient. A flexible tube is sometimes used in this connection, and in addition a second tube, reaching from the ear of the patient to the ear of the operator, is employed, so that the latter may hear the effect of the current, as in Fig. 89. The whole instrument is known as Toynbee's otoscope. The accompanying illustrations exhibit these tubes and their modes of employment.

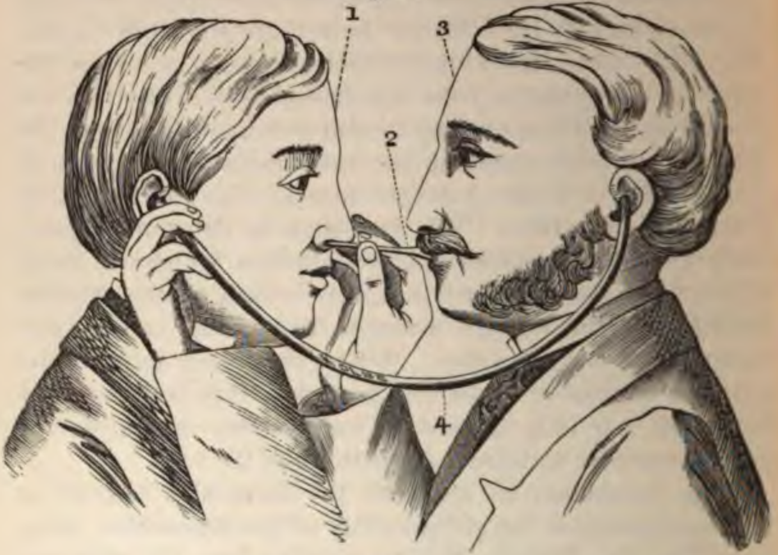
Fig. 88.—Explorer, with Eustachian Catheter attached.



IMPERVIOUS EUSTACHIAN TUBE.

"Of the means more especially used to open an impervious tube, the nitrate of silver of the strength of forty or eighty grains to the ounce, applied to the mouth of the tube by means of the Eustachian catheter, is considered by Dr. Pomeroy,* of New York, one of the best. He recommends

Fig. 89.



1, the patient; 2, Eustachian catheter; 3, the surgeon; 4, the india-rubber diagnostic tube or Toynbee's otoscope.

its use in the following manner, and we have tried the method and approve of it:

"The end of the catheter containing the ring should be supplied with a thimble-shaped piece of rubber, similar to that used on atrophine-dropper; the beak of the instrument is immersed in the solution, and one or several drops may be drawn up, the end freed from excess of solution by wiping on blotting-paper, then passed up to the Eustachian tube, or perhaps a little way within, and the contents discharged. Or, after loading the instrument, a bit of cotton may be wound upon the end, and when introduced the thimble-shaped bulb may be slightly pressed, so as to moisten the cotton when a swab is extemporized, and being exactly in position, the remedy is readily applied."

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* The Treatment of Naso-Pharyngeal Catarrh in its Relation to Diseases of the Ear, by O. D. Pomeroy, M.D., Medical Record, March 15th, 1871, p. 30.

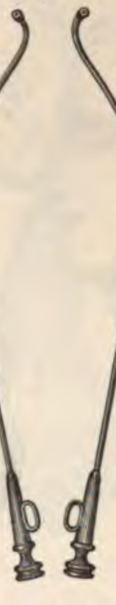
THE PHARYNGEAL OPENINGS OF THE EUSTACHIAN TUBE.

Having had the opportunity of examining and studying some interesting cases of cleft palate, we have come to the following conclusions: that there is a peculiarity of articulation or nasal voice. This is accompanied by more or less deafness. There is also disease of the mucous membrane, which is congested, harder and dryer than natural, owing to constant exposure to the air.

The muscles have not as much power to control the pharyngeal openings of the tube, so that in the act of swallowing they remain so long open that in two cases particles of food passed along the dilated tube; and was stated by one of the patients to have been removed from the external meatus. In both these cases perforation of the membrana tympani had taken place.

In the case of Mary N., aged fifteen years, of Rome City, Indiana,—a patient of Dr. Cohen,—by simply drawing back the cheek we could distinctly see through the cleft both mouths of the Eustachian tubes, and watch their action. These openings were triangular or obliquely oval, looking downward, outward, and forward. They showed that, to enter these openings by the catheter, required it to be curved for three-fourths of an inch in depth, in a downward direction, for the terminal two inches, with the tip curved one-eighth of an inch to the right or left, to enter with facility into the mouth of either tube.* (See Fig. 90.) It also required a slight rotary movement to the right for the left opening, and vice versa to enter; but once entered, it retained its position firmly, in spite of violent shaking of the head. The ordinary catheter of Kramer† is of six and a half

Fig. 90.



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[*] These catheters were made by G. P. Pilling, gold and silver surgical instrument-maker of this city.

[†] Kramer on Diseases of the Ear. Translated for New Sydenham Society, London, 1863, p. 27.

inches in length, with a beak bent laterally for three-quarters of an inch at an angle of 144°; this could not be introduced in this case without painful pressure upward of the soft tissues of the nose; and yet all the parts were perfectly normal in appearance. Although this was an independent observation to study the feasibility of an improvement in the curve of the catheter, it was found, on consulting some old works, that *Saissy* pictured a somewhat similarly-shaped catheter in his celebrated "Essay on the Diseases of the Ear," published originally as an article in the "Dictionnaire des Sciences Médicales," in 1819, and translated with additions by the distinguished surgeon, Prof. Nathan R. Smith, of Baltimore, from the posthumous edition published by "Montain" in 1827.

Fig. 91.

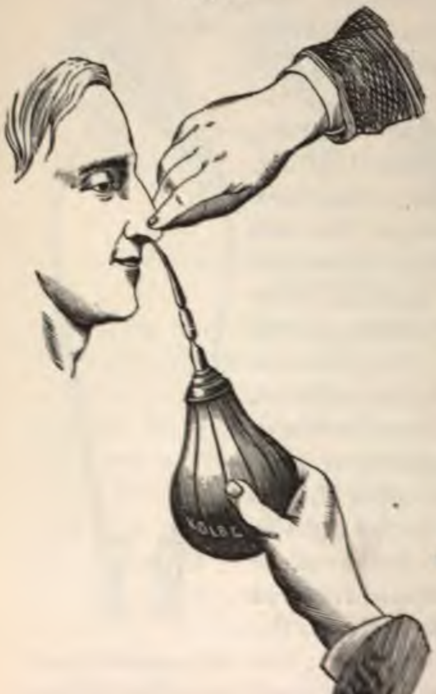
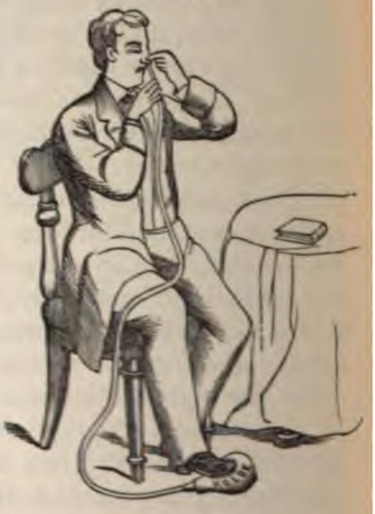


Fig. 92.

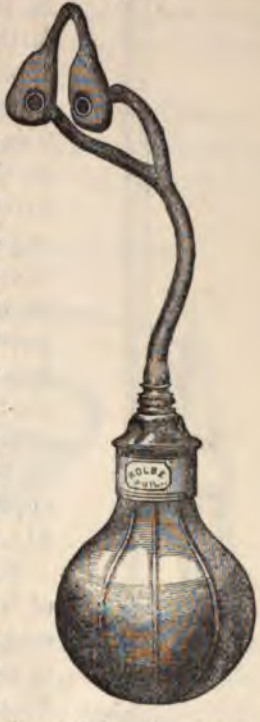


Both the catheter of Saissy and that employed in the case referred to, differ in their curvature from the catheter of Toynbee.

In one other case examined by Dr. Cohen one year after a successful operation for closure of both hard and soft palate, he found a perforation of the membrana tympani. The deafness was moderate, but marked; and on questioning the patient as to the entanglement of food in the Eustachian tube, it appeared that it had also occurred in this case previous to the operation; but that since the operation there had been no difficulty of this kind.

These observations do not confirm those of Dieffenbach, that the impairment of hearing was always completely relieved after closure of the fissure of the palate by sutures. They show, however, the importance of an early operation, before the tissues have received such profound alteration that they are unable to return to their normal condition.

Fig. 93.



Politzer has devised an apparatus, which we have before described and frequently employed, for examining and inflating the middle ear through the Eustachian tube by the nose, which, though less exact than the catheter, often answers the purpose. His method consists in placing a tube attached to an elastic bag with a valve at its base into one nostril, compressing the other upon it, and forcing a current of air as the patient swallows saliva, or a mouthful of water held for that purpose. This is of easy application, and suitable to practitioners who cannot manage the catheter.

Fig. 91 exhibits the instrument, and its manner of application; Fig. 92 shows Dr. Brunton's* modification, which the patient can employ without the aid of the physician, the compression of the bag being made by the foot the instant the patient swallows, which is well illustrated in the cut.

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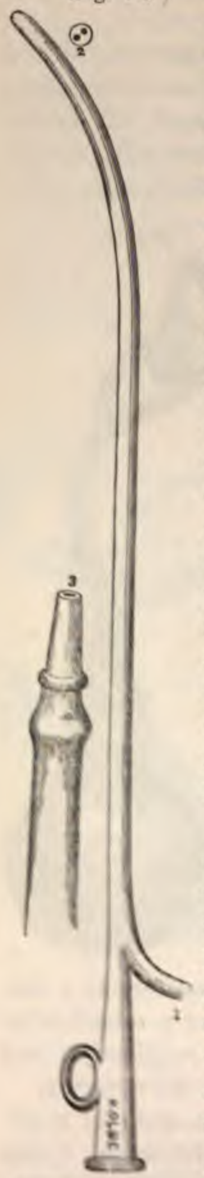
* Braithwaite's Retrospect.

Fig. 94.



A still more recent change in the form of this apparatus has been made by Dr. Peter Allen,* which we have received from John Weiss & Son, of London; but we can express no opinion of its utility until further trials. It is described as follows: "I have still further improved Politzer's most invaluable appliance, by substituting a *nasal pad*, which is pressed *against* the opening into the nostrils, for the tube which he inserted into one of them. Mounted on a strong piece of covered copper wire are two air pads, which can be so approximated or separated as to stop up conveniently the nasal orifices. The metal serves as a handle for the surgeon or patient. Through each pad runs a hole, and these holes communicate with two short bits of india-rubber tubing, joining into a single tube. Into this tube the pipe of the inflating-bag is inserted, and the apparatus being thus complete," is shown at Fig. 93.

For the introduction of minute quantities of liquids, or the spray of the same into the middle ear, we have several instruments. It is most generally accomplished through the Eustachian tube. A very convenient instrument will be found in the spray catheter,† in which Richardson's apparatus is placed within a catheter, which is movable in any direction. The difficulty in the use of this instrument is that the end gets clogged by mucus, and thus arrests the operation, requiring the removal of the catheter; to avoid this, rapid pumping will sometimes dislodge the mucus.

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* Lectures on Aural Catarrh, by Peter Allen, M.D., Aural Surgeon to, and Lecturer on Aural Surgery at, St Mary's Hospital. London, 1871, pp. 78, 79.

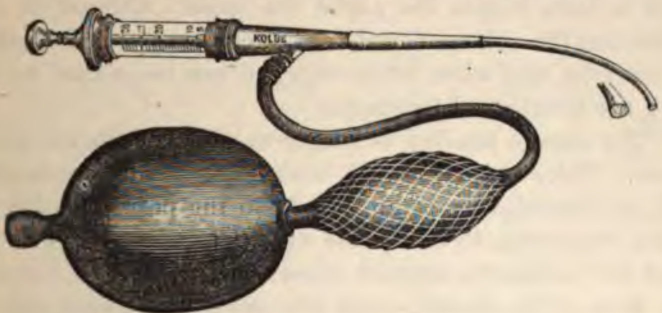
† Made by Messrs. Codman & Shurtleff, of Boston.

A still better form of catheter is shown at Fig. 94, which can be freed from obstructing mucus without removal from the Eustachian tube. The tube is double, so that one stream is passing in while another is passing out. No. 1 is the exit tube; No. 2, double orifice for entrance and exit of fluids; No. 3, tube for air-bag, or syringe for introducing liquids.

We can with this double catheter wash out the pharyngeal extremity of the Eustachian orifice, or introduce a few drops of liquid and spray it by means of the air-bag and drive it in this state into the middle ear.

Another form for the same purpose is called Bishop's* nebulizer, with which he states lotions of any strength, up to the point of saturation, may be used; but the quantity required to come into contact with the whole lining membrane is so small that there is not the least fear of mechanical injury, and by slightly turning the point of the instrument the pharynx, the nasal passages, and the parts connected therewith, may all be subjected to the action of the remedy. The apparatus, as seen at Fig. 95, consists of a small graduated glass syringe, similar to that used for subcutaneous injection. The solution is gently forced drop by drop into a

Fig. 95.—BISHOP'S NEBULIZER FOR EUSTACHIAN TUBE.



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* On a New Method of Applying Remedial Agents to the Cavity of the Tympanum, by Edward Bishop, M.D., pp. 8, 9.

cylinder, and at the point where it leaves the nozzle of the syringe it is caught by a current of air sent by a pump worked by the hand. This drives the fluid forward in a pulverized state. The apparatus is then attached to an ordinary Eustachian catheter, previously introduced,—the end of the catheter being covered with a fine gauze wire.

Before closing what we have written upon the subject of the Eustachian catheter, we take pleasure in noticing briefly the form devised by Dr. Henry D. Noyes, of New York,* "especially when the catheter is introduced by the opposite nostril:"

"I may with modesty remark that I have not found the forms figured by Kramer for the ordinary instrument the most suitable; the error, in my judgment, being that the beak is too long, and the sweep of the curve too great.

"The catheter of 1½‴, or a little more than 3mm. in size, I have come to prefer. For a larger size I would have the beak a little larger, the curve the same. Curved in such a manner, the catheter finds entrance readily to the mouth of the tube, and when fairly engaged can be pushed up into it by the thumb and forefinger.

"The change needful is simply to give the beak a double curve. Take the elongated beak generally recommended, and, at three-eighths of an inch from the point, bend it in a plane transverse to the plane of the primary curve. This bend will always be upward when the catheter lies flat upon the floor of the nostril,—but the same instrument will not serve for both sides, because the secondary curve is in opposite directions when used for the right or left sides.

"When introducing the catheter, it is needful to keep the point close to the septum as well as to the floor of the nostrils. Arrived at the posterior edge of the septum, the beak should wind closely around it,—curving obliquely across and turning upward, so as to point toward the Eustachian orifice.

"It is better always to use the left hand for the left Eustachian tube, and the right hand for the right.

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* Transactions of the American Otological Society, 1870, pp. 81–84.

"I find it better not to push the point back to the pharynx and then draw forward, but rather to aim at once for the ostium when the mark on the straight portion of the instrument shows that the beak is near its destination. I always inspect the nostril with speculum and mirror before putting in the catheter, so as to learn the peculiarities of the passage; and it is advisable to dip the end of the catheter in glycerine to lubricate it. I always give the patient the usual directions about holding the mouth a little open, to aid relaxation of the soft palate."

CHAPTER XV.

WOUNDS—INJURIES—PERFORATIONS OF THE MEMBRANA TYMPANI—ACUTE AND CHRONIC INFLAMMATION.

Wounds of this membrane are rare, owing to its situation, the depth of the meatus, and its tortuous canal.

It is injured in fractures, by blows on the side of the head, falls, concussions, or sharp vibrations of air.

Sir Astley Cooper relates a case of laceration of the membrane by a blow on the side of the head, extending from above downward across the entire membrane.

I have seen a number of cases in which there were both lacerations and cicatrices of the membrana tympani. As a general rule, this form of wound heals with great facility, without treatment. The same result from disease would take a much longer time to heal. There is a form of deafness, the result of loud, sharp reports, to be found in both officers and men belonging to our artillery corps; but in raw recruits it assumes the form of hemorrhage from the meatus from laceration of the membrane.

RUPTURE OF MEMBRANA TYMPANI BY STRANGULATION.

Dr. Alfred Taylor, in his Medical Jurisprudence (Philadelphia edition, 1856, p. 575), mentions a case of *suicidal* strangulation in which constriction had been produced by a ribbon, and the violence applied was sufficient to produce bleeding from one ear. On dissection, there was found to have resulted a rupture of the membrane of the drum of the ear.

Von Tröltsch mentions two instances of perforation by a blade of straw; and I have met with a similar injury in a boy. Another case which came under my observation was where the membrana tympani was ruptured by a blow from a pillow, thrown with great force against the ear.

Treatment.—Absolute rest, depletion of a local character, if there be pain, one-quarter to one-half grain of morphia injected hypodermically, with a solution of sulphate of zinc, gr. i to x in one pint of water, applied warm, by means of Clarke's douche. Cotton or wool should be placed in the meatus, to exclude the air, and careful attention required until union is complete, for if neglected it is apt to be tedious. The membrane, if properly treated, will heal without difficulty.

The manubrium, or the handle of the malleus, is inclosed for about three-fourths of its length between the laminæ of the membrana tympani.

This delicate bone was first found to have been broken and united in the case of one of the lower animals. Soon afterward a similar fracture was discovered by Mèniere* in a gardener, who had accidentally thrust a twig of a pear-tree into his ear. A very extensive laceration of the membrana tympani took place, and the little bones of the ear could be plainly seen, and their movements distinguished. It is stated that this injury healed of itself, without any special treatment.

Prof. Von Tröltsch also reports a case of united fracture, caused by the thrust of a pen-handle. The translator of Von Tröltsch's work furnished a case from Dr. Weir, of New York, of ununited fracture of the handle of the malleus.

"The man received a fall, which caused unconsciousness and bleeding from the ear. He had pain in his ear for sixteen hours, running along the forehead to the ear; was laid up for a month, and the pain passed away. The tinnitus aurium is very great. On examining the right ear, the handle of the malleus seems to have been fractured just below the short process, where an irregularity is seen, and the lower fragment moves with great freedom upon the upper. The irregularity disappears after inflating the ear by the Valsalvian method. On the posterior part of the drum a patch of increased whiteness is seen, and possibly it indicates the site of a rupture of the membrana tympani."

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* Gazette Médicale de Paris, 1856, No. 50; Von Tröltsch, Treatise on Diseases of the Ear, translated by John Roosa, M.D., Am. ed., pp. 151–153.

INFLAMMATION OF THE MEMBRANA TYMPANI (MYRINGITIS), ACUTE AND CHRONIC.

Having already treated of this important membrane when considering acute affections of the meatus auditorius, otitis, acute and chronic, externa and interna, we shall not devote as much space to the acute as to the chronic affections of the membrane; as the latter subject has assumed great importance from the investigations by Toynbee into the change produced by this form of inflammation, in which he has been followed by Wilde, Von Tröltsch, and still more recently by Politzer, who has surpassed them all in the care, accuracy, and completeness of his investigations of the subject in reference to a true diagnosis.

Acute affections of the ear are very amenable to therapeutic agents; but in chronic affections of all organs it is most difficult to arrive at a correct diagnosis and successful treatment,—the ear being no exception to this rule. As is well observed by Politzer, "An accurate examination of the membrana tympani is indispensable for a complete and exhaustive diagnosis;" and we can fully agree with him, when he says that, in many cases which he has examined, there are changes in the membrane to which no impairment of function whatever corresponds. On the other hand, experience teaches us that, in some cases, with a marked degree of deafness, the membrana tympani does not present the least departure from the normal condition; so that the condition of the membrane should only be taken in conjunction with all other symptoms, but is never to be depended upon alone as a safe guide in diagnosis.

In acute inflammation of this membrane, there is always great vascularity and pain; usually the attack of pain is in the night, and is of the most excruciating character, producing at times delirium. It is increased by chewing or swallowing, or by the least pressure behind the ear, which is the only means of diagnosing it in little children. There is a feeling of fullness and bursting within the ear. If not treated promptly, the pain extends to the throat and mastoid region, or may pass into the brain. Almost every patient has some form of his own for expressing the noise or tinnitus aurium felt in the ear. In every instance there is deafness, either partial or complete, of the side affected, as in most of the cases it is one ear that has been exposed. The chief cause of this disorder is cold, but other agencies will produce it, as foreign bodies, attacks of various diseases, the exanthemata, bronchitis, typhoid and typhus fevers, and phthisis. In almost every instance there is more or less swelling of the lining membrane of the external meatus, and therefore we cannot, in the very early stage, see the membrana tympani. From numerous examinations, where they can be borne by the patient, or when under the influence of chloroform or ether, it is seen that the membrana tympani loses its polish and its semi-transparency, and assumes a pink, and subsequently a rose tint, with numerous vessels crossing it, forming a network, commencing at the insertion of the malleus, with here and there patches of ecchymosis. If it progresses, exudation of lymph and muco-purulent secretion takes place with perforations, either by abscess or slough. As soon as the perforation occurs, there is temporary relief. If resolution takes place, the vascularity decreases, and the membrane ultimately recovers its natural appearance, but is apt to assume a muddy or opaque character, or is covered with numerous spots.

Treatment.—Our sheet-anchor is local depletion, with purgatives, and relief to the pain by morphia, or hydrate of chloral, or the hypodermic injection of sulphate of morphia; the use of moist heat by the spray or douche; subsequently blisters, with iodine and tonics, to promote absorption of the deposits. The adhesions are to be broken up by the use of warm water by the catheter or Politzer's apparatus. After all inflammation has disappeared, the air douche must be employed, and the opacity dusted with calomel, while we administer internally the iodide of potassium, in five- to ten-grain doses, three times a day, largely diluted with water, until local inflammation is again set up, when we must let the parts rest for a time.

CHRONIC INFLAMMATION OF THE MEMBRANA TYMPANI.

In this form of inflammation there is one important element wanting, and that is pain, and there are but few exceptions to this general rule. It is characterized by a general thickening and opacity of the membrane, progressing for months or even years, giving no warning except a gradual and slowly increasing deafness, which is sometimes noticed by the friends of the patient before he is himself aware of it. Sometimes we have a collapse or falling-in of the membrana tympani, with anomalies in the transparency and color. These anomalies are in part owing to the arrangement of the several layers as before noticed,—an external dermoid and an internal mucous: the dermoid is an extremely delicate continuation of the lining of the external meatus, which, in its transition to the membrane, consists of an epidermic layer, a Malpighian mucous layer, and the cutis. The middle fibrous layer consists of two separate laminæ, an external radiate, and an internal circular.

The first form of chronic disease of the membrane, according to Politzer, is softening of the epidermic layer, the appearance of which becomes dull and lustreless, and is generally the result of serous exudation. It occurs in the beginning of acute catarrh of the cavity of the tympanum, in the rare forms of idiopathic myringitis, and in the outset of otitis externa.

Then follows congestion of the dermoid layer, which is generally seen on the handle of the malleus, indicating chronic inflammation of the tympanic cavity. There is also a circular wreath of vessels near its periphery, from which little converging branches run toward the centre of the membrane; this is especially the case in acute catarrh of the tympanic cavity, or in relapses of chronic catarrh.

Case of chronic inflammation of the tympanic cavity, with collapse of membrana tympani.—June 4th, 1869. E. M. D., aged fifty-eight, residence Chelton Hills, Pa., applied on account of deafness of right ear, which has been of eighteen months' duration,—the result of cold. Has been under treatment for one year without benefit.

Examination.—Right ear: cannot hear the ordinary watch close to the meatus when the other ear is closed, or on the temporal bone, but can hear the tuning-fork. Left ear: can hear the watch* fifteen inches; can only hear one sound or one individual voice at a time; but if more than one, the sound becomes confused, and he has a sensation of closing or shutting in the ear. His hearing, when young, was so acute that he could distinguish, even in an adjoining apartment, the faintest sound, so that his friends had to be very careful what they said when he was near. Meatus dry, but of normal color; membrana tympani very concave; reflection of light feeble; handle of the malleus not well seen from congestion of its vessels; sounds from Eustachian tube of left side normal; of right side faint and moist.

Rhinoscopic examination.—Mucous membrane swollen; orifice of Eustachian tube covered with gray mucus; follicles of the pharynx red and enlarged.

Treatment.—Chlorate of potash five grains three times daily; iodine and ether, by means of Politzer's air douche, through the Eustachian tube.

June 18th, 1869. Treatment continued; no change noticed.

Sept. 21st. Slight improvement, could hear the watch close to right ear.

October 6th. Directed the use of Politzer's air douche, so as to cause the air to reduce the concave character of the membrana tympani. Prescribed an alterative mixture, as follows:

R.—Iodide of Potassium, grs. v;
Sol. of Arsenite of Potassa, gtt. v;
Muriate of Ammonia, grs. x;
Extract of Licorice, grs. x;
Water, ℥ij. M.
Sig. Three times a day.

He continued to take this mixture at intervals for a month, having the current from Kidder's battery applied to the ear every third day in the following manner: the conductor leading to the positive pole or anode was held in the patient's left hand, whilst the opposite conductor or cathode, ending in a funnel-shaped conductor, was placed in the meatus of the right ear, which was filled with warm salt-and-water. The current was by this means brought to bear upon the membrana tympani, and made to pass directly through the head, instead of making a short cut through the skin. Subsequently the battery was applied in the same manner every sixth day.

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* Ordinary hearing distance of this watch is from two and a half to three feet.

Oct. 13th. Has rheumatism from exposure,—not the first attack; directed bath of bicarbonate of potassa, and continuance of mixture, with astringents to the throat.

Oct. 26th. Can hear the watch about three inches from the ear.

Nov. 17th, 1869. Is in high spirits; hearing distance for watch ten inches; membrana tympani less concave; now able to hear any one of his family at table five or six feet off. Same treatment continued up to January, 1870, when he was discharged much improved.

February, 1871. Hearing continues good, his brother-in-law informing the author that he considered his hearing all right.

Next to congestion of membrana tympani, Politzer places ecchymoses that occur in catarrh of the middle ear.

He considers their recognition, by inspection of the membrane, to be very easy. They appear as irregular hemorrhagic spots, in varying number, sometimes sharply defined, sometimes faint, and especially frequent behind the manubrium.*

In still higher grades of acute catarrh, especially when accompanied by purulent secretion, the membrane, before perforation, appears so reddened that individual ramifications of vessels can no longer be seen. The same good authority states that the general opacities of the membrana tympani depending on a lack of transparency in the *substantia propria*, arise either by immediate transmission from the other layers of the membrane, or are secondary to affections of the deeper-lying structures; and they also occur independently in old age. "On examination in the living subject, the membrane thus changed appears flattened and uneven, in consequence of several unequally-clouded portions. The color is dirty bluish-white like lustreless porcelain, or the yellow predominates, and the membrane may be compared to a lamina of leather."

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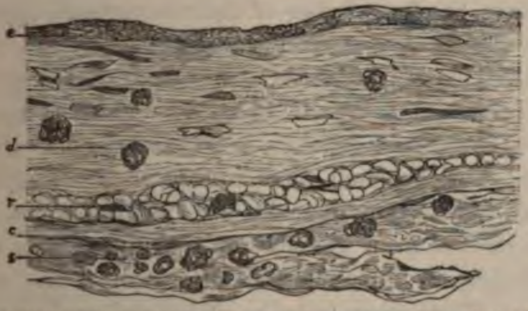
* Politzer, translation, op. cit.

OPACITIES FROM CHANGES IN THE MUCOUS LAYER OF THE MEMBRANA TYMPANI.

In acute catarrh of the cavity, without perforation, the membrana tympani has a bluish-red color, on account of congestion of its mucous layer. In chronic cases, and these, according to Dr. Politzer, are the most frequent, the membrane is either bluish-white, with a tendinous opacity, or dirty-gray, and usually dull, having the appearance of ground glass, or glass covered with vapor upon one side.

The following illustration is from an interesting microscopical section of a diseased membrana tympani, in which we have simple fatty degeneration, from Prof. Gruber,* according to whose investigations it is a condition frequently connected with chronic aural catarrh.

Fig. 96.



Section of a fatty degenerated tympanic membrane of a patient suffering from a chronic catarrh of the cavity of the tympanum. *e*, epidermis; *d*, dermoid layer; *r*, radiating layer; *c*, circular layer; *s*, layer of mucous membrane.

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* Lehrbuch der Ohrenheilkunde, p. 461.

In the dermis, membrana propria, and mucous membrane are seen partially crystalline and partially scaly masses of fat, by which the membrane becomes very tender, and tears readily.

Atheromatous or calcareous deposits, according to Wilde,* are seated in the anterior vibrating portion. This deposit is of a yellowish color, and has a sharp, well-defined edge, totally different from that of a lymphy exudation, which generally shades off into the surrounding membrane. If scratched with a cataract-needle, it will be found to be gritty, its composition being carbonate of lime. Wilde believes that he was the first to notice this peculiar condition, which he stated in his essay upon Otorrhœa, in 1843. Toynbee has given three illustrations of this form of deposit, and states that it is found in the fibrous lamina, and that in some instances the whole of the membrana tympani is converted into calcareous matter. This change may occur at all periods of life, sometimes taking place when the remaining portion of the membrane is healthy. In other cases he considers it symptomatic of calcareous deposit within the tympanic cavity. In others, it follows, and appears to be produced by, chronic inflammation of the dermoid layer with or without catarrh. Politzer says, the knowledge of their occurrence appears to be of earlier date than is generally supposed. In an old work of Cassebohm† (1734), he finds a description of a preparation of the membrana tympani of an old woman, upon which there were calcareous deposits in front of the manubrium and behind it. Von Tröltsch gives a more accurate account. He says, such calcareous deposits are, for the most part, distinctly separated from the surrounding tissue, and with their yellowish-gray or clear, whitish appearance, are not to be mistaken. They occur even in childhood, and are not at all infrequent.

With the exception of a few cases in which the hearing was tolerably good, he has hitherto found them only associated with a high degree of deafness; so that the existence of similar earthy processes on the membrane of the fenestra rotunda, or about the foot of the stapes, may be inferred. Moos, of Heidelberg, was the first to study carefully the gradual formation of these calcareous deposits; the case selected was an old woman seventy years of age, in the course of a chronic catarrh of the middle ear. Since that statement, Dr. Politzer has had a similar opportunity of following up the development of these deposits.

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* Wilde, Practical Observations on Aural Surgery, p. 276.

† Tractatus quatuor anatomici de Auri humani, 1734.

The following case is from Politzer's clinic, and is worthy of notice, from the fact of the patient's retaining an almost normal degree of hearing, notwithstanding the existence of a serious lesion:

"Woman, aged twenty, a patient with tuberculosis, in Oppolzer's ward, Vienna General Hospital. The aural examination was made in this case, not from any symptoms of disease of the ear, but in accordance with the general custom in this clinique. With both ears, the watch was heard at a distance of one foot, and the voice, in a whisper; the length of the ward about ninety feet. Examination of the membrana tympani showed in each a perforation about 2½''' in length, and situated behind the manubrium mallei; the remainder of the membrana, with the exception of a small rim at the periphery, was infiltrated with calcareous deposit. When a child, the patient had severe pain in both ears, followed by a discharge, but no deafness.

"Death occurred a few days after this examination, and an autopsy confirmed the observations above described. In the fresh state, the calcareous mass was so firm as to be immovable under a strong pressure, and the deposit had not only impregnated all the layers of the membrani tympani, but extended above the surface of the mucous membrane into the tympanic cavity, and the malleus was so firmly imbedded that no vibration could have been transmitted by it to the other ossicles. The patient was able to hear, and had heard since childhood, inasmuch as the perforation permitted vibrations to pass into the tympanic cavity, and fall directly on the stapes, which was freely movable. The labyrinth was perfectly normal. Had the opening been closed by cicatricial tissue, it would have been necessary to make an artificial perforation, in order to permit the passage of vibrations and to give to the patient the degree of hearing which, as the case stood, she possessed up to the time of her death. The importance of retaining or reproducing a perforation of the membrana tympani in some, and by no means infrequent diseases of the ear, is illustrated by this case. It also shows that opacity in the membrana tympani alone is not always a cause of deafness."*

Schwartze has confirmed the previous observations. They are not always an attendant upon, or an absolute cause of, deafness, for Politzer has found them after death in persons whose hearing had been normal. He regards them as the product of otorrhœas that have passed away. Besides the circumscribed opacities, we find tendinous, gray, oblong, and uniformly faint or striped areas, which are separated by either normal or slightly-clouded portions; a condition such as is often met with in chronic catarrhs, and after otorrhœas, but also frequently enough in persons of normal hearing, especially in old age.

"As regards diagnostic value, the result of clinical investigations may be summed up in the following points:

"1. Diseases of the membrana tympani are, for the most part, combinations of the signs of disease of the external and middle, less frequently of the inner ear.

"2. Opacities occur frequently in aural disease, according to the unanimous testimony of authors, and, in many cases, afford important data for a diagnosis.

"3. The fact, however, that analogous opacities occur also in persons with normal hearing, diminishes their diagnostic value not a little. Nevertheless, they deserve, in given cases, full consideration; since, taken in connection with other signs, with the nature and course of the case, and the degree of functional impairment, they often essentially facilitate the diagnosis."†

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* C. G. Blake, M.D., Boston Med. and Surg. Journal.

† Politzer, op. cit., p. 69.

PERFORATION OF THE MEMBRANA TYMPANI.

The most frequent cause of this solution of continuity of the membrana tympani is purulent catarrh of the middle ear, and the disease which produces the largest number of cases of purulent catarrh is scarlet fever; next to this is cold and its consequences; then follow phthisis, measles, pneumonia, typhus and typhoid fevers, pertussis, and, in a small number of cases, eczema, puncture, etc. In almost all there is a softening of the tissue; and the pus, or mixed pus and mucus, in the cavity of the tympanum or middle ear, exercises a strong pressure on this softened membrane, until laceration takes place.

In phthisis, the cough will often cause a sudden pressure of air in the cavity, which may terminate in a rupture of both membranes. I recently watched the ruptured membrane in a case of phthisis, and there was a gradual increase of the size of the perforation every few days, until there was but little left of it. In this disease pain seldom, if ever, attends the destruction of the membrane. In the post-mortem examination of such cases, Politzer has found the mucous membrane of the middle ear pale, seldom hyperæmic, and covered with a thin layer of creamy muco-purulent secretion; and in the membrana tympani, usually at its lower segment, an irregular perforation, from a line to a line and a half in diameter, the border of the opening being softened and collapsed in folds.

The occurrence of the perforation of the membrana tympani is usually indicated by pain in the ear, accompanied with more or less deafness. Examination of the ear with a speculum in a bright sunlight, or with the concave mirror, shows the perforation either in the centre or through the lower half of the membrane. In acute cases the author has seen the first faint dark line or spot which indicates perforation. This was shown to be such by the patient blowing air through it, on closing the nose and mouth, and making forced expiration. The cases most difficult to heal are those following scarlatina; while those produced by acute catarrh, or puncture, heal more readily, if the perforation is not of large size. When more than one-half of the membrane is destroyed, it rarely heals.

Recently I have had under treatment two cases which healed in three months; but the majority require many months, and even years, to accomplish the closure. In another place the exanthematous affections of the middle ear have been fully treated of, and the great importance pointed out of giving early attention to them.

The treatment of simple subacute perforations will depend somewhat upon the cause; but generally they require antiphlogistic measures: leeches or cups, with warm fomentations and brisk purgation. Opium or its salts, with or without antimony, at bedtime, will hasten the cure. The after-treatment will consist of blisters behind the ear, with a mild astringent wash of sulphate or acetate of zinc, with the addition of tinctura opii; this treatment applies to all cases of acute perforations.

Chronic perforation.—In cases of perforation of long standing, we resort to solutions of nitrate of silver, 20 to 30 grs. to f℥i of water, or solutions of iodine or carbolic acid, applied with great care, by means of a brush or piece of cotton, not oftener than every third day. At the same time we should attend carefully to the constitutional treatment by alteratives and tonics; and keep the pharyngeal orifice of the Eustachian tube open and free from mucus, by means of Politzer's air-bag or its modifications, so that there may be a free connection with the throat. Thudichum's nasal douche will be found useful, if the nose and throat are affected, as is frequently the case.

Syringing, as a general rule, should be forbidden, and, when necessary, the modification of Thudichum's apparatus by Dr. Clarke should be preferred for the purpose. The danger from syringing is the liability of increasing the size of the perforation. The pus and other matters that accumulate in the ear should be removed at least daily by the use of a little cotton or soft sponge moistened in tepid water; and, to remove fetor, a few drops of Burnett's solution of chloride of zinc, diluted (one part to twelve of water), or a weak solution of carbolate of zinc should be used. Mr. Hinton recommends drying-powders, such as magnesia, chalk, etc. Solutions of the acetate of lead are very objectionable, as there is danger of deposits of lead being formed, even when the solution is rendered acid; although the danger is thought to be lessened by this measure. The application of solid nitrate of silver to the edges of the perforation is attended with risk of increasing the size rather than leading to its diminution. The local application should simply stimulate the edges of the perforation to a sufficient degree to increase the activity of the circulation, and favor the closure by granulation. This is done with great facility by melting the salt in the platinum ladle (Fig. 97), and applying it by Livingstone's elastic caustic probe (Fig. 98).

Should suppuration or a free discharge from the middle ear exist, this must be gotten rid of before the opening can be closed. The proportion of cases in which closure takes place is one in five; such, at least, accords with the experience of the author.

Two cases of perforation, successfully treated, are added, by way of illustration:

CASE I.—Mrs. Anna A., American lady, aged thirty-five, married. Whilst attending the opera had a seat near an open door. In the course of the following night she was attacked with a pain in the ear, which was described as radiating into the head, causing intense suffering, in spite of the free leeching, purgation, and anodynes, both local and general, which had been used by her physician. She was not relieved until a discharge took place from her ear, which continued for some time, when she became alarmed at her deafness, and consulted the author. Upon examination, I discovered a small linear perforation, situated about the centre of the membrana tympani. The walls of the meatus were red, and covered with a discharge, which I removed. The surface of the membrana tympani was injected with blood. The edge

Fig. 97.

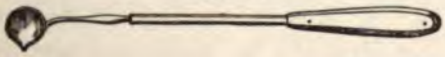
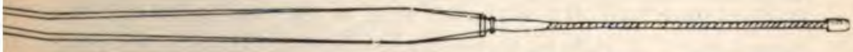


Fig. 98.



of the perforation was touched with a solution of nitrate of silver, gr. xxx to f℥i of water, every third day. A solution of sulphate of zinc, gr. i to f℥i of water with f℥ss glycerine, was dropped into the ear by a competent nurse, and removed by careful syringing. A blister was applied behind the ear, and Politzer's bag employed to keep the middle ear free, by inducing a discharge from the pharyngeal orifice. Gradually the diffuse redness of the membrana tympani disappeared, and, under the influence of the blister and the wash, the aperture became closed in a month, without much diminution of the hearing power on that side.

I saw the patient one year afterward; she has had but one return of the catarrhal affection, which was promptly relieved by an astringent wash.

Case II. was much more tedious, requiring six months to heal the perforation, but this was owing to the debility of the general system caused by the disease. M. E. T., German, aged forty-nine; had contracted a remittent fever whilst visiting the Sulphur Springs, Va. His fever was very high, brain affected, etc. He convalesced, and was able to ride about, when his ear began to discharge. This continued for some time before he sent for me. When seen, the meatus was red and swollen, and no examination could be made for several days. When the swelling subsided, I was able to see, by the aid of a speculum and Von Tröltsch's reflector, a perforation at the bottom of the membrane, through which, with some difficulty, air could be forced by expiration. The treatment was the same as the preceding case. Fomentations and leeching, however, were required to reduce the swelling of the meatus. It was six months before the aperture healed up; and although he hears ordinary conversation, yet when the watch is applied to that ear, it can be heard only at one-half the distance that it can be heard by the sound ear. A visit to Germany during the summer of 1868 has improved his general health and, with it, his hearing. I directed him during the extreme cold weather to obtain fro W. Oakford a pair of his ear-protectors, and wear them windy cold weather. They are made of velvet, lined wi oil-silk, and by means of an elastic cord, going over the hea kept in place. They allow the air to circulate in the ear, without confining any discharge.

In 1859, the author published an account of "The Use of the Artificial Membrana Tympani, by the late Mr. Toynbee," and reported some cases of his own; but at that time the use of this little apparatus was not well understood, because the designer of it was himself in error in regard to its proper application and theory of action. Mr. Yearsley certainly deserves most of the credit for the practical application of his piece of wet cotton, and also for his theory of its mode of action, which he published to the world in 1848; and subsequently, on June 6th, 1857,* he states: "The more experience I have of this important invention the more I am satisfied that my theory of its modus operandi is correct, and Mr. Toynbee is decidedly wrong, and that so surely as he succeeds in shutting up the opening in the membrane, as surely does he fail in improving the hearing, whatever be the material employed, whether it be the original wetted cotton, or the substitution of vulcanized rubber." Again, in Dec. 1857, he stated the true theory of its action, which was subsequently accepted by Mr. Toynbee (being led, he tells us, to do so by witnessing a demonstration by Mr. Julius Erhard), that hearing might be improved by the pressure of cotton-wool on an entire membrane, and coming now to the conclusion that it was by restoring contact occasioned by some disconnection, or loss in the ossicular chain. Thus, as the Supplement points out,† he approached the opinion long held by Mr. Yearsley, that the cotton-wool supported the ossicula. As the matter now stands, Mr. Yearsley is the inventor of this application, and thus states the case in his own words: He maintains that to be successful the orifice in the membrana tympani must neither be filled in, nor completely covered by, the cotton, and that an opening must be left along the walls of the meatus, down to the site of the membrana tympani.

The following is a condensed statement of answers to questions addressed to his patients: I apply it only to the end of the passage, and on one side. (1) Were I to cover the passage entirely, I should be more deaf than I am. (2) If I do not introduce the cotton down to the (opening), and place it on one side, I find it more than useless. (3) I find it to have the desired effect by placing it on one side only, so as to preserve an opening down to the tympanum. (4) I still apply the cotton remedy, as at first applied by you, at the side and the end of the passage. (5) I do not cover the external part of the drum, but I place it sideways toward the back, leaving a small opening.

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* London Med. Journ. and Gaz., June, 1857.

† The Diseases of the Ear, by the late J. Toynbee, F.R.S., with a Supplement by James Hinton, M.R.C.S., Aural Surgeon to Guy's Hospital. London, 1868.

One of the chief objects of the cotton is, according to Mr. Yearsley, to rupture the air bubble (indicated to the patient by a distinct *click*); and secondly, to prevent the re-formation of bubbles of air in the discharge in and around the perforated membrane. Simple as it would appear, it is an operation requiring the most delicate tact to manipulate the nice adjustment of the cotton. A very convenient way of applying it is to pass a linen or silk thread through the centre of a bunch of cotton-wool, and tie it so as to hold the wet cotton by the thread. The free ends of the thread can then be passed through a straw quill, or silver tube, two inches long, and by this means the cotton or wool can be carried down through the meatus to the edge of the perforation, but not to cover it entirely. When it is accurately adjusted, the tube is withdrawn, and the cotton left in position. The cotton can also be adjusted by means of a pair of forceps, in little cylinders on the handle of the malleus in case of nervous deafness without perforation, as recommended by Dr. Erhard,* who claims to have been the first to have found the method of curing deafness by pressure on the membrana tympani on his own ear, and to have published it in 1849.

This is not a new idea, for in both modern and ancient literature there are cases related where deaf patients have accidentally found that by introducing a foreign body into the meatus the hearing was temporarily improved.

Mèniere† relates an interesting case: An old judge had been accustomed, for at least sixteen years, by pressure of a blunt gold needle against the membrana tympani, to improve his hearing for an hour or two. Mèniere examined the ear during this state of things, and found the membrana tympani uninjured, and that the pressure was upon the handle of the malleus. He states that he had seen several similar cases, and considered them cases of nervous deafness.

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* Rationelle Otiatrik, pp. 274, 275. Erlangen, 1859.

† Traité des Maladies d'Oreille, par Kramer, traduit par Mèniere. Paris, 1848, p. 526.

It will be remembered that in long-continued discharges from the ear of a purulent character, there is often a separation of the little bones. As most of these cases commence in the middle ear, the loosening of the capsule of the joint of the long process of the incus takes place, separating it from the stapes; but if the membrana tympani, with the incus, be pressed against the stapes, the connection will be restored. Should there be no handle of the malleus or incus left, there is not much prospect of any improvement by pressure; still, if the stapes is alone, with a portion of the membrane left, a partial success will follow. In two cases, out of many in which the author employed the artificial membrana tympani of Mr. Toynbee, the improvement in hearing must have followed from the contraction of the artificial tympani, as in every instance it was his endeavor to fit the membrane carefully and accurately over the opening. It is almost impossible, from the shrinking of the material, to preserve a shut sack. At Fig. 99 may be seen the form of the artificial membrane of Toynbee.

CASE I. *Chronic purulent catarrh, or chronic otitis interna, with perforation of the membrana tympani; application of an artificial membrane with success.*—James Riddle, aged twenty-four, a native of Ireland, by occupation a silk weaver, applied January 21st, 1858, at "Western Clinical Infirmary,"* on account of a troublesome discharge and deafness in his right ear, the result of scarlet fever, of which he had a severe attack at the age of thirteen. He had become so deaf in the right ear as not to hear the tick of a watch when placed in immediate contact.

On examination with Wilde's speculum and a good light, the meatus was found filled with mucus, pus, etc.; upon removal of which, by careful syringing with warm water, a large opening was found in the membrana tympani, near its centre, and the membrane lining the meatus thickened and contracted. Astringent and stimulating injections were now employed to change and alter the secretions, and as there were some enlarged cervical glands, he was ordered five grains of iodide of potassium three times daily, in a bitter infusion, with counter-irritation behind the ear by cantharidal collodion. In the other ear there was thickening of the membrana tympani, and, from this cause, deafness.

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* Former name of Howard Hospital.

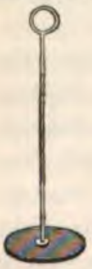
January 26th. Discharge has moderated, but hearing not improved. Found, on examination, that air did not pass through the Eustachian tube. Introduced the Eustachian catheter at two different sittings.

Jan. 29th. Same treatment; improving.

February 9th. Discharge still less. Introduced the moistened cotton; but, after remaining in for a few days, it increased the discharge. Although removed and cleansed each night, he complained that the itching was so intolerable that he desired its removal, which was done, and injections resumed.

Feb. 12th. Introduced an artificial membrana tympani, made by Mr. Kolbe, of this city, which gave him no pain, and his hearing was slightly improved. (See Fig. 99.)

Fig. 99.



Feb. 15th. The discharge is again on the increase; has blackened the silver wire, and caused the artificial membrane to wrinkle and change its color, so that it was removed, and the ear allowed to rest.

Feb. 18th. Again introduced the membrane. It is more comfortable to-day; can hear best in the open air, and reintroduced the membrane himself, finding out the right spot; for, if he pushes it too far, it is of no use to him. He has been testing his powers of hearing by a clock.

Feb. 24th. Returned to-day, and states that he cannot hear so well; when, upon examination, found the Eustachian tube blocked up with mucus accumulations, which were again, removed with a series of injections of warm air; and on filling up the ear with a weak solution of sulphate of copper, and by making an effort to swallow, with the nose and mouth closed, air passed up in bubbles through the liquid.

This effort to swallow with nose and mouth closed he was directed to make, when his artificial membrane was out, so as to keep the tube pervious.

Conclusion.—This patient continued to visit the Infirmary twice a week until 17th of March, when he left for the country, having but slight discharge, and being able to hear conversation with ease and comfort, and even the ticking of an ordinary clock across a room.

CASE II. *Scrofulous inflammation of the membrana tympani; perforation; and successful use of artificial membrane.* — Wm. C. N., sailor, aged twenty, native of Philadelphia, came under my care in the beginning of October, 1860, sent to me by Professor J. A. Meigs. I found his hearing very defective in right ear; the membrana tympani had almost all disappeared, save a small ledge. In this ear I advised him to use an artificial membrana tympani, of Mr. Toynbee's, which I obtained of Mr. Weiss, of London. With the left ear he was unable to hear his watch, unless in contact with his temporal bone. I introduced the Eustachian catheter with great difficulty and with much care; the air passed, apparently for the first time, into the middle ear; it was heard by the use of the otoscope by Drs. Burpee, Tryon, and Buchanan. I continued to use it, but he complained of much pain over the brow and eye; while holding his mouth and nostrils closed, passes air into the cavity himself, and finds his hearing improved by it, being able to hear his watch in contact with his ear.

Treatment continued for one month; no more improvement. Artificial tympani having given way, a second one (made by Mr. Kolbe under my direction) was introduced, which he states he cannot hear without.

The internal treatment consisted of Fowler's solution of the arsenite of potassa, with cod-liver oil.

The following is his statement after being under treatment about two months:

"Dr. L. Turnbull.

"Dear Sir,—I have no remembrance of ever hearing with my left ear. If the ear was perfect in the performance of its function, it must have been while I was very young. My right ear was perfect until October, 1859. Whilst I could hear with it, it was very acute; so much so that I was marked as being quick at hearing.

"In March, 1858, I contracted a severe cold, which by neglect settled on my left lung. About five weeks after I contracted the cold, swellings began to appear on my neck, first on the right side then on the left. These proved to be scrofulous swellings. In June, 1859, one of them opened, and remained open till last April. In October last, whilst my neck was in the above condition, I experienced a sudden loss of hearing, and my right ear commenced discharging matter, which it has kept up ever since,—although the discharge at present is very small. I was advised to syringe it daily with lukewarm water and Castile soap or milk. About last March I commenced to use cotton and glycerine; I continued to use these until June; I then procured some wool, and every two or three days would put a small piece dipped in glycerine close to, or rather on, the drum-head. This improved my hearing very much; I continued to use it for seven or eight weeks, and latterly the ear became painful; I went to Dr. J. A. Meigs, who examined my ears with a speculum. He said the right ear was very much inflamed; that there was a perforation in the membrane; that the upper part hung down like a curtain over it. The left ear had the membrane very much thickened; also the lining membrane of the tube. He told me to introduce with a quill a few drops of a solution of nitrate of silver (two grains to one ounce) in my right ear daily, so as to allay the inflammation; also to use with a brush citrine ointment in my left ear, for the purpose of thinning the membrana tympani. I did so for a week, and went to him again. My left ear became very painful under the action of the citrine ointment. In washing it out every morning, filmy matter would come from it. Upon examining the right ear again, there was a great decrease of inflammation, but the opening was much larger.

The left ear had become much inflamed. Dr. Meigs then told me to stop using the ointment in the left ear and use the caustic solution until the inflammation was brought down, when I was to begin again to use the ointment. For the right ear I was to increase the strength of the solution. I asked Dr. Meigs the cause of the defects. He stated that a small ulcer had formed on the membrana tympani, and perforated it. Upon looking at it first, he thought he could close the opening by touching it with caustic; but when he examined it again, the upper part of the membrane had resumed its place, and the opening below was much larger. At first it was about as large as o, the second time O. The defect in the left ear was owing to a thickening of the membrana tympani caused by a severe cold.

"At present I use nothing in my right ear, except the artificial membrane which you gave me. It improves my hearing considerably. My left ear has improved somewhat under your treatment. I can now hear the ticking of a watch, which I could not do before.

"Yours respectfully,
"WM. C. N.

"PHILADELPHIA, Oct. 1860."

"*Chronic purulent inflammation of the tympanum* is often an accompaniment of perforation of the membrana tympani, and the following are Lucae's* methods of treating chronic purulent inflammation of the tympanum. In the majority of these cases he has found that they were accompanied by granulations, not only in the middle ear, but along the Eustachian tube and in the pharynx, and this condition of tube and pharynx keeps up the inflammation in the ear. He directs treatment more especially to the Eustachian tube, and has seen the best results from the insufflation of dry powders through the catheter into the tube. For this purpose he recommends muriate of ammonia, sulphate of zinc, alum, acetate of lead, and sulphate of copper. The addition of a small amount of camphor to any of these he thinks is of advantage. The powdered sulphate of copper is the most valuable in granular pharyngitis. The advantages of the powder over strong solutions are, that we get the greatest action in the tube where it is needed, without the risk of inflammation of the tympanum from the unexpected entrance of considerable quantities of fluid. Where only a very mild action is required, Lucae prefers the injection of liquids by Gruber's method. For the granulations in the tympanum, sulphate of copper in substance or solution (from two to five grains to an ounce) is highly recommended.

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* Monatschrift f. Ohrenheilk., No. 4, 1870; Berliner Klinisch. Wochenschrift, No. 6, 1870; Transactions of the Am. Otol. Society, 1870.

"One cause of the frequent failure to cure in these cases is the insufficient or imperfect application of the astringent instillations. To remedy this, Lucae uses what he calls a prolonged ear-bath, by means of which he keeps the solutions applied to the desired parts for any length of time, without interfering with the occupation of the patient. A medium-sized glass tube is bent at a right angle, with a long arm about one inch in length, and a short arm about one-half inch in length. The long arm is covered with rubber tubing, and inserted tightly into the meatus; into the shorter arm, which stands upright, the solution is instilled drop by drop, till the tube is nearly full. The patient is now able to move about, and the solution can be thus retained as long as desired. Previous to these applications the ear is to be thoroughly cleansed by the double current (catheter, see Fig. 94) already described. At first, the solution is retained for half an hour twice a day, but the length of time can be increased to several hours if desired."

"Nasiloff* has described, as a new form of *inflammation of the membrana tympani* (*myringitis villosa*), a shaggy condition of the dermoid layer of that membrane, which seems to have been an inflammation and hypertrophy of these papillæ. Kessel also accepts this name, and describes† a condition of the membrana tympani similar to that given by Nasiloff."

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* Centralblatt f. d. Med. Wissensch., 1867, No. 11.

† Archiv für Ohrenheilkunde, vol. v. p. 250, and Transactions of the Am. Otol. Society, 1870.

CHAPTER XVI.

DISEASED THROAT, UVULA, TONSILS, AND CARIOUS TEETH, IN THEIR RELATIONS TO DISEASE OF THE EAR; ALSO FEIGNED DEAFNESS.

HAVING in a previous chapter treated of the anatomy and pathology of the posterior portion of the naso-pharyngeal space and of the necessity of a rhinoscopic examination, with the catheterization of the Eustachian tube, we shall in this chapter direct our attention to the anterior portion of the nasal passage and mucous membrane lining the pharynx, arches of the soft palate, uvula, and tonsils. The importance of this subject cannot be overestimated, for it is a well-recognized fact, demonstrated by a large practice, that in a considerable number of cases the catarrhal deafness is either directly or indirectly the result of acute or chronic inflammation of this portion of the mucous membrane which lines these parts, and is extended to the orifice of the Eustachian tube, middle ear, and mastoid cells. In such cases of deafness we must endeavor, both by topical and constitutional means, to restore the throat to a healthy condition; for on the slightest increase of disease in this part in certain individuals their deafness is augmented. An enlarged pendulous uvula filled with serum, causing cough, must be reduced by cutting off a portion, followed by the application of astringents and stimulants, to restore it to its normal condition.

The throat in the acute catarrhal inflammation is red, tumid with injection of the superficial blood-vessels, with fever and pain, and more or less secretion, which becomes thickened; in the chronic form there is either a great accumulation of mucus or extreme dryness. The acute condition is to be treated by depletion, direct or from the skin and intestines, mucilaginous and anodyne drinks, astringent gargles, etc.; the chronic form, by those agents that will restore tone and vigor to the capillaries and build up the broken-down constitution.

Enlargement of the tonsils.—This depends upon a semi-solid organizable material, effused into the tissue connecting the cellules or lacunæ of which the gland is composed. In the adult it becomes organized and much more firm; in children there is in most instances a reabsorption; but in some cases it remains permanent.

The symptoms of enlarged tonsils are more or less impediment to the breathing, compelling the individual to sleep with the mouth open; snoring in sleep; a thickness or peculiar twang of the voice; some difficulty in swallowing, and often *deafness*. The tonsils may either project toward the middle of the throat and almost touch, or they may grow upward and downward, so that in looking into the open mouth but a small portion of the enlargement is seen unless the finger be passed into the fauces or a hook inserted and the gland drawn up.

If the enlargement is in an upward direction, it may obstruct respiration through the nose and also the passage of air through the Eustachian tubes.

Dyspnœa and difficulty of swallowing depend upon congestion or inflammation of the tonsils, to which persons having such enlargement are very subject, and which inflammatory attacks extend to the cervical glands and mucous membrane of the fauces. Deafness in almost all cases is due, according to the best authorities, to chronic thickening of the mucous membrane of the fauces near the enlarged tonsils. Tröltsch[*] says this is particularly shown by examinations on the dead body. In recent subjects we often find the mucous membrane of the middle ear, at the same time with that of the pharynx, in a state of congestive swelling, hyperæmia, and hyper-secretion. Johannes Müller says the mucous membranes have a great tendency to communicate their affections along their course.[†] "We see," observes Tröltsch, "that affections of the mucous membrane are often extended

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[*] Tröltsch on the Ear, translated by Prof. Roosa. New York, 1869.

[†] Handbuch der Physiologie, 1844.

'per continuitatem.' Catarrhal inflammation of the conjunctiva and lachrymal sac occurs from coryza, and the inflammation of the buccal cavity, in typhus fever, extends through Wharton's duct to the little glandular canal of the parotid."

It is well known that constitutional diseases—typhus fever, tuberculosis, and the acute exanthemata—very often extend themselves from the pharynx to the mucous membrane of the ear. If the tonsils, therefore, are abnormally large, he (Tröltsch) advises their removal; for if they are not themselves the seat of frequent inflammation and abscesses, they retain the chronic congestion of the pharynx by their presence, since they act as foreign bodies and prevent the normal action of the muscles of the throat. They also push the broad portion of the soft palate upward, and thus, but not in a direct manner, as is generally believed, press the anterior lip of the Eustachian tube against the posterior.

In advising the removal of the tonsils, we should be governed by their condition. If they are not much diseased, or if their enlargement cause no inconvenience to the patient, they should not be removed. If, however, there is impediment to breathing, a nasal voice, frequent attacks of sore throat, and, above all, deafness, then their removal should be effected, no matter what is the age of the sufferer. The operation is simple, and not often dangerous. It is stated that Dr. James Yearsley, of London, has operated in more than *three thousand cases*, without a single accident or unfavorable result. M. Guersant* says he has operated on more than *one thousand children*, and can hardly reckon more than three cases out of this number in which formidable bleeding occurred. On the other hand, he has operated on about twelve or fifteen adults, and must confess that four or five at least of them claimed his attention, and it was not possible, without the use of the actual cautery or the sesquichloride of iron, to arrest the bleeding.

After relating two instances in which the hemorrhage was not only copious but absolutely alarming, Prof. Gross says:* "Since the publication of the first edition of this work, I have met with two other cases of severe bleeding after this operation,—one in a youth of eighteen and the other in a man of thirty. The hemorrhage was quite copious, but finally yielded to the application of the tincture of the sesquichloride of iron, aided by a full anodyne."

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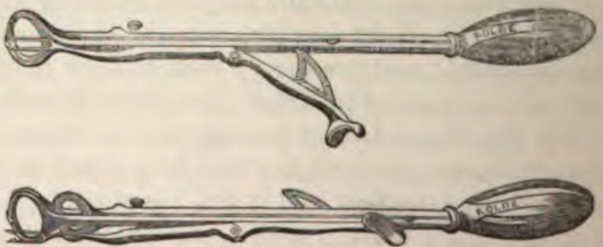
* The Surgical Treatment of Diseases of Infancy and Childhood. By. T. Holmes, M.A., Cantab., p. 555.

Erichsen refers to a case in which the hemorrhage was effectually arrested, after the failure of all other means, by a gargle of spirits of turpentine suspended in mucilage. We have had cases in which there was profuse hemorrhage, but by the use of ice, tannic acid, or dry persulphate of iron the bleeding was checked.

There are three methods of removing the tonsils, viz., with the forceps and knife, with the tonsillotome or guillotine, and with some powerful caustic paste. The first mode is applicable to all cases, the second to children, and the third is to be used where the patient has a dread of the knife.

The forceps should be long and hooked, and the knife should be a probe-pointed bistoury, which should be guarded to within about an inch and a half of its point. The enlarged tonsil is seized with the forceps and drawn as far as possible into the mouth. It is then divided by passing the knife from below upward, only cutting off the upper portion drawn into the mouth, being careful not to wound the tongue or soft palate.

Fig. 100.



The principal tonsil instruments are Mathieu's, Physick's, and Fahnestock's. This latter instrument, which has been modified by Charrière, of Paris, is the one we employ. It consists (as in Fig. 100) of two blades, sliding on one another, and terminating in a ring. The posterior edge of the upper ring is sharp. On the upper blade a groove is chiseled, along which travels an arm, which carries a double-pronged fork; and this arm is so constructed that, as it passes over the ring, the fork is raised a certain distance away from ring.

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* Gross's System of Surgery, vol. ii. p. 375.

The frame is provided with a handle on either side, for the first two fingers of the surgeon's hand, and one behind for his thumb. The frame is so connected with the fork and blades that, by pressing the thumb forward, the operator first projects the fork, and then the upper ring, as in Fig. 100. The instrument being put into the mouth, usually depresses the tongue sufficiently. It is then turned, with the lower ring toward the tonsil and pressed upon it, so as to draw the tonsil into the ring; then, by pressure of the thumb, the prongs of the fork are struck into the enlarged tonsil, and as the fork passes forward, it draws the gland farther into the ring; then, by continuing the pressure of the thumb, the upper ring slides forward and cuts off the part within the ring, as in lower part of figure. As observed by T. Holmes,* the whole affair is over in a moment, and the main recommendation of the guillotine is that it only requires one hand, so that any opposition not too resolute can be overcome, the mouth kept open, or the tongue depressed with the other; while, in operating with both hands, the surgeon often finds himself foiled just at the moment of commencing his incision, by the child shutting its mouth in terror, or in beginning to struggle. Besides, when once the fork has been struck into the tonsil, the operation is over; while, in operating with the knife, the child sometimes tears himself loose after the section has been begun, with a scrap of tonsil hanging down in his throat. It is well to have several sizes of rings of the instrument, as often one will not fit into the mouth of the child or youth. In all operations for excision of the tonsils in which chloroform (or ether, or a mixture of the two) is employed, and in many cases where the child is merely a little unsteady and frightened, the gag, devised by

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* Surgical Treatment of the Diseases of Infancy and Childhood.

Mr. T. Smith, for operations on the soft palate, is recommended.

It is made of stout wire, bent to the shape and soldered on to a tongue-plate. The horizontal portion fits inside the lower teeth, and the plate keeps the tongue out of the operator's way. The upper branches fit inside the upper teeth, lying close under the superior maxilla, and, when open, maintain the jaws apart. They are opened and closed by a screw. The whole is kept in position by a strap passing around the child's head; the branches connecting the upper and lower portions lie in the corners of the mouth and keep it widely distended. A somewhat similar instrument was devised by Dr. Mussy, of Cincinnati, and by Mr. Hohlmann, of the firm of Tiemann & Co., of New York, a figure of which may be seen at p. 448, Transactions Am. Med. Association, vol. xx. 1869.

With respect to hemorrhage, Dr. Holmes writes: "It has not been my lot to witness any formidable hemorrhage in either of these operations." He also regards the after-treatment quite unimportant. Prof. Gross considers it prudent to confine the patient to a moderately warm apartment; at all events, he should avoid cold air, and, if necessary, on account of the resulting inflammation, he should take an active cathartic. For want of attention to this, he states that "several lives have been lost that might otherwise have been saved."

The third plan for removing enlarged tonsils is that proposed by W. J. Smith* and Dr. Morell Mackenzie,† of London. Smith's method consists in the repeated application of the potassa fusa *to their surface by means of a small metal dish*, mounted on a handle. The dish being heated over the flame of a spirit-lamp, is filled with potassa fusa by rubbing a heated stick of that substance into it, and is then pressed on the surface of the tonsil. Thus a portion is destroyed; and when the slough has separated and the symptoms produced by the caustic have subsided, it is to be reapplied. The interval will probably be about a week, and the number of applications required, even in cases of no inordinate extent, seems, according to Holmes, to be not less than five or six. He also states that the application causes considerable pain in the parts, in the ears and throat, with swelling of the glands, etc.; but no alarming symptoms have ever occurred, beyond a temporary spasm of the glottis, twice repeated in a child, in whom, however, the treatment was successfully carried out. He also claims for it a superior efficacy in cases in which the enlarged tonsils are flat, deeply buried behind the arches of the palate, and growing upward toward the opening of the Eustachian tube.

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* On the Treatment of Enlarged Tonsils at any Period of Life without the Operation of Excision. London, 1865.

† Medical Mirror, 1864.

Dr. Mackenzie gave the name of "London paste" to his agent, which consists of a mixture of equal parts of *caustic soda and lime*. Forty cases are cited (1864) in which it had been used by him with complete success. We have tested this paste to a limited extent, so far, with success. It is moistened with absolute alcohol on a piece of glass or porcelain, and applied by means of a glass rod, being careful that the paste be not too thin. The pain is not generally severe; the paste acts at once, adhering to the tonsils and causing a deepening of the color, and in a day or two an eschar is formed.

In one instance there was pain following the application, which continued for two days, and the child, a girl ten years of age, would not again submit to its use; yet so large a quantity had been employed that the tonsils were reduced nearly one-half. If by any means too much is employed, the parts should be washed, or the throat gargled with vinegar and water, followed by olive oil, which removes the unpleasant taste. If the tonsils are very much indurated, a good plan is to remove a small portion by the knife, and then apply the escharotic paste. In several instances we have succeeded by this plan in removing altered or nasal voice, irritable throat, and deafness, especially in young lads.

DEAFNESS FROM CARIOUS TEETH.

Deafness is often dependent upon the want of teeth, and sometimes an *artificial set* will restore the hearing.

In other instances pain and even deafness will be caused by decayed teeth. Mr. Cattlin* describes a case in which the loss of hearing was evidently reflex paralysis, caused by a carious tooth:

"In the month of September, 1843, a lady in the second stage of consumption consulted me concerning a diseased right lower molar. She had for about three months suffered acute pains in the tooth, ear, and side of the neck. When I saw her she had become deaf for four days. The inflamed tooth was extracted, and her hearing returned within an hour after the operation."

In another instance a diseased molar tooth caused ulceration of the auditory canal. I shall quote Mr. Hilton's† account of it:

"Some years ago Dr. Addison had a very offensive discharge from the auditory canal of one of his ears, which annoyed him very much, and below the external ear was a small gland, enlarged. He had tried various remedies for this discharge, and had gone, I believe, to some surgeons who attended especially to the ear; but, as far as I could learn, no good resulted from any of their applications. Upon examining the ear from which the offensive discharge proceeded, I found a slight ulceration upon the floor of the auditory canal. On arguing the question out between us, we came to the conclusion that the ulceration probably depended upon a diseased molar tooth in the lower jaw on the same side. We had that tooth extracted, and in a very short time the ulcer healed; the discharge and morbid secretion disappeared from the auditory canal, and as soon as that ulceration was cured the enlarged gland subsided."

OTALGIA (EARACHE, OR NEURALGIC PAIN IN THE EAR).

This will often occur in children without any apparent inflammation or warning. Tincture of opium applied in the ear with an equal quantity of olive oil will generally relieve it. In the adult suffering from intense pain in the ear we have found useful equal parts of glycerine and chloroform, or the oil of belladonna, or hyoscyamus, alone or combined with morphia. M. Emile Duval* says "that he has in person found relief in severe earache, after other means had been tried in vain, from the use of a mixture of equal parts of chloroform and laudanum; a little being introduced on a piece of cotton. The first effect produced is a sensation of cold; then there is numbness, followed by scarcely perceptible pain and refreshing sleep."

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* Transactions Odontological Society, vol. iii. p. 308, London, 1863; Guy's Hospital Reports, Third Series, vol. xiii. p. 94, London, 1868.

† On the Influence of Mechanical and Physiological Rest, etc., by John Hilton, F.R.S. London, 1863, pp. 194–199.

In cases of very severe neuralgic pain radiating from a tooth to the ear, the following pill will often be found useful:

Sulphate of Quinia, gr. i;
Extract of Belladonna, gr. $\frac{1}{12}$;
Sulphate of Morphia, gr. $\frac{1}{12}$.
Make into one pill.
S. Give one every three or four hours.

If this do not relieve the pain, apply a lotion of acetate of lead, chloroformi and pulv. camphoræ, partis equalis. Should the pain still continue, administer hypodermically one-third of a grain of the solution of the acetate or sulphate of morphia.

FEIGNED DEAFNESS.

As deafness may occur without any change in the appearance of the external ear, it is a favorite disease to simulate. The modes of detecting it are obvious. A watch should be set on the suspected person day and night, and things calculated to excite interest or apprehension should be uttered in his presence and the effect carefully noted. It has been recommended to place the fingers on the pulse while any bad news or threat of punishment is being uttered. The patient should be called sharply or unexpectedly by name, or in a whisper, or he should be roused from sleep and spoken to, or a piece of money should be let fall close to him. All these and similar tests have failed, and sometimes even the loudest noises have not produced any apparent effect. In one case related by Dunlop, a pistol was fired off close to the ear without effect; but upon putting the man to sleep with opium the imposition was detected on the repetition of the firing.

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* Gaz. Méd. de Lyon, i., July, 1861.

(Anæsthesia produced by ether or chloroform has been advantageously used.)*

Dumbness.—This is sometimes assumed with great perseverance. As a general rule, it may be stated that if a man not deaf can move his tongue, he is not dumb. Some add to feigned dumbness a pretended mutilation of the tongue, which they effect by rolling it back into the throat, and scratching it to make it bleed. A relation of Dr. Guy's detected this fraud in the case of a man who, by a written paper, describing his captivity among the Algerines and his mutilation by them, had excited great commiseration. Pretending to give entire credence to the man's tale, and taking a half-crown out of his pocket, he requested the man to show him his tongue once more, upon which he thrust his finger suddenly against the root and the tongue rolled out. My own observations lead me to believe, however, that this test is not always to be relied upon.

Deaf-dumbness.—The combination of deafness and dumbness, though never occurring in a person previously in possession of the faculties of hearing and speech, is sometimes obstinately pretended. In one or two remarkable instances, men who have pretended that they were born deaf and dumb have resisted every test, and have been detected only by those having personal experience with the really deaf and dumb.†

Dr. Casper (Handbuch der Gerichtlechen Medicin, tome i.) gives the two following instances of feigned deafness: A female, convicted of theft and imprisoned, complained that the dampness of her cell had rendered her deaf. Even when addressed in the loudest tones she appeared not to hear. Suspecting her veracity, the doctor pretended to believe her, and to prescribe for the disorder. On one occasion, while visiting her, he exclaimed aloud, "Good heavens, there is vermin here!" And suddenly turning towards the prisoner, said, in a very low voice, "Madam, you have a louse on your right sleeve." The woman instantly turned, and examined her right arm, with a motion of evident disgust.

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* Loss of Speech and Hearing successfully treated by Inhalation of Ether, by J. H. Hutchinson, M.D., Amer. Jour. Med. Sciences, vol. xlvii. p. 412.

† Guy's Forensic Medicine. London, 1869, p. 153.

The next instance is that of an old woman who was tried for an assault upon a female with a sickle. The prisoner pretended to be sick, feeble, and completely deaf; and no amount of voice on the part of the court sufficed to make her understand anything. Casper was thereupon called in, who, from the bearing of the woman, at once suspected her of feigning. Approaching her ear, he shouted, "You are accused of having grievously wounded Mrs. Lemke!" "It's a lie," replied the prisoner. "But," rejoined the doctor, "Mrs. Lemke would not say so were it not true, for"—suddenly dropping his voice into a whisper—"you know Mrs. Lemke is not a liar." "She is a liar!" exclaimed the prisoner aloud, pushed by the spirit of revenge to gratify her hatred even at the expense of exposing her own deception.

A plan adopted by some of our army surgeons, during the late war, to detect malingerers feigning deafness, was to drop a large book or other body suddenly behind the suspected person. If deaf, his attention would be attracted by the jar, and he would turn around to ascertain the cause of the concussion, but if a malingerer, he would not move a muscle. In the early history of the New York Deaf and Dumb Institution, it is stated that a man presented himself as a deaf mute, and as having been educated in France. Some doubt was entertained as to the truth of his statements, and it was decided to test his pretensions to deafness by dropping on the floor a metal basin containing heavy things to make a noise. The experiment was made, and he stood the test without flinching, as was supposed. He was treated kindly and dismissed with presents. Shortly afterwards he was heard from, as being in prison for some offense against the law, and it was found that he could speak and hear as well as anybody. In fact, a true deaf mute would have been startled by the concussion. In general, people pay but little attention to jars. A few years since, in England, an opposite inference was drawn from a similar experiment, and an impostor detected.*

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* Annual Report of Pennsylvania Institution for the Deaf and Dumb, 1868, p. 19.

FEIGNED MUTISM DETECTED BY A STRONG AND PROLONGED SHOCK OF ELECTRICITY.*

"On the 16th day of July, 1859, a boy about fourteen years of age was taken up in the street for begging, and committed to the House of Refuge by one of the aldermen of the city. At the time of his arrest he intimated to the officer that he was unable to speak. He could, however, evidently hear perfectly well. He wrote his name in the alderman's office as John Thompson, born in the State of New York, and gave his age as thirteen years. At the Refuge he also gave them to understand that he could not speak, and that he had lost the ability to articulate sounds in his early infancy. He was found to be able to read with facility anything that was written for him, and he wrote a quite distinct and well-formed hand himself. My colleague, Dr. Haskell, who was on duty at the time of his admission, examined him carefully, and desired that he should be closely watched, so as to detect if possible whether his mutism was feigned or not. From that date, however, up to the close of February, a period of nearly eight months, during which he was constantly at work or at play with the other boys, no one ever heard him utter a single distinct word save once, shortly after his admission, when he was locked in his room for some misdemeanor. He then called to a boy passing the door to know if the bell (for dinner) had rung. When accused immediately afterwards with having uttered these words, he admitted that he had, but indicated his inability to repeat the same or any other words, even under the threats of punishment. His whole conduct, subsequently, was so very consistent with his statements that those of the managers and officers with whom I conversed in reference to his case, expressed themselves convinced of the boy being either unable, or under a delusion as to his ability to talk. Indeed, one of the managers, who took a special interest in the boy, wrote me in February a letter in regard to him, requesting me to examine him carefully as to the possibility of any surgical operation being performed to restore his voice; and if such was not possible, that I should recommend his being sent to the Deaf and Dumb Asylum. On my first interview with the boy I found him remarkably bright, with an expression of face quite characteristic of deaf mutes. He had a restlessness of eye and remarkable quickness of manner. He communicated with me very freely with the single-hand alphabet, which he stated he had learned whilst in the institution from one of the teachers. To my inquiry as to where he had learned to read and write so well, he gave me to understand that his mother had shown him the letters and taught him their meaning; that she had been very devoted and assiduous in her efforts to teach him. The teacher from whom he stated he had learned the mute alphabet, assured me afterwards that he had never shown him the letters but twice. His organs of speech, on careful examination, were found by me to be in a perfect state. His palate, tongue, fauces, and larynx were, as far as I could ascertain, perfectly natural, and to my frequent solicitations for him to utter a single word or letter, I got only a negative shake of the head. The boy evidently would not attempt to articulate a sound, and the fact that he had spoken once in the institution satisfied me that there was merely an unwillingness, and not an inability, to speak. I also made frequent attempts to get him to utter some sounds. At first he would not, then he gave utterance to a squeaking guttural sound. Then, by dint of perseverance, I got him to pronounce after me some labial sounds, such as *b*, some of the hissing sounds, such as *c* and *s;* but I never could get him to attempt the distinct lingual and guttural sounds by which I hoped he would betray himself. My conviction of his feigning was not in any way, however, diminished by these interviews, although my researches in works on feigned diseases and medical jurisprudence were not rewarded by the discovery of a single case approaching to it; but, on the contrary, in the appendix of Mr. Wilde's work on the Ear (see p. 438, American edition), I there saw some cases of real mutism so analogous to this one that I might well have had some misgivings as to the

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* Dr. A. Hewson, Transactions College of Physicians. Philadelphia, June, 1861.

[illegible] especially with the strong testi- [illegible] officers of the institution in oppo- [illegible] however, that the boy had been [illegible] admitted that he had, was an insur- [illegible] expedients presented themselves to [illegible] I might be able to determine the [illegible] strong shock of electricity, and the [illegible] agents. I determined to try the [illegible] accordingly on Saturday, the 20th of [illegible] of my friend, Dr. Charles Lee, I [illegible] of the induced current from a [illegible] apparatus, by means of moistened [illegible] the larynx. This application, I [illegible] his voice back, and I told him I [illegible] he made some effort to speak—until [illegible] sound. He held out for some [illegible] although the application was [illegible] Finally, however, he cried in quite [illegible] "Enough!" I then ceased; and then feel- [illegible] had been severely punished, I did [illegible] although he would not utter [illegible] On the following Monday I intended to [illegible] if it was not more successful, to put [illegible] ether. When he saw me, how- [illegible] in the hall, with the battery [illegible] and in company with my col- [illegible] came forward and said, in a slow, [illegible] as though he articulated with diffi- [illegible] sir?" and I was informed that he had [illegible] his voice since I had used the [illegible] He reiterated, in answer to my in- [illegible] to his history. Some of those [illegible] confident were not correct, and I told [illegible] me he was telling the truth. He [illegible] and in the course of a few days it was [illegible] read poetry in a very creditable [illegible] questioned as to where he had learned to [illegible] measure, he quickly answered that he [illegible] reading poetry at the public school near Brooklyn. He now became quite a lion, and when I took him before the managers to induce them to resort to some coercion to get at the truth in his case, I found the most experienced of them under the conviction that I had either brought the voice to a child where it had never been developed, or that the child had been suffering under hallucination that he could not speak. These impressions prevailed for six weeks, when one day the boy, of his own free will, gave the superintendent the following statement in his own handwriting:

"'PHILADELPHIA HOUSE OF REFUGE,
"'May 4th, 1860.

"'Having feigned to be deaf and dumb for about nine months, and made several erroneous statements while in this institution in regard to my history, I now truthfully declare that my object in doing so was to avoid the possibility of detection as a runaway from my parents, who reside in Alleghany City, opposite Pittsburg, on the Alleghany River, in Pennsylvania. I left Alleghany City on the 1st of July, 1859. I took with me a box partly full of lozenges, so as to make my parents believe I would sell them. When I got to the river I commenced to call the boys' attention by daring feats; at last I got a thick plank, and went out into the middle of the Alleghany River. I floated down the river on it, and the boys on the shore thought I was drowned. I suppose I must now come back to Mr. S. S. East,—he was a newsdealer in Alleghany City. He always trusted me, and I now owe him two dollars and a half, which I would like to pay very much. He resides near the depot. I then traveled partly through Ohio, and from Ohio to New York City. Stayed there two or three days, and then came to Philadelphia on Monday, July 16th, 1859. I am not induced to make the above statement through fear of punishment, but that I may be relieved of a great uneasiness which I feel on account practicing such a deception.

"'CHARLES L. C., alias JOHN THOMPSON.'"

CHAPTER XVII.

NERVOUS DEAFNESS.

I HAVE endeavored to bring together the important facts in regard to one of the most obscure forms of diseases of the human ear, namely, "nervous deafness."

Definition.—By "nervous deafness" is generally understood "a diseased condition or impaired function of labyrinth and auditory nerve;" but, in my judgment, it should also include affections of the nerves which supply the external ear, membrana tympani, and middle ear in their reflex influence. The term *nervous*, in a truly scientific sense, is not correct, but it is the best term we have at present for indicating the probable origin of this form of deafness.

Etiology.—This form of disease is often the result of hereditary taint, being communicated from parent to child.

In one family, consisting of two sisters and one brother, every member was deaf, in another two, and in a third there was one deaf in the family, for three generations.

Sedgwick* has observed that a surgical instrument-maker, aged twenty-nine years, became deaf, like his father, at the age of eighteen years; and Dr. Camp informed him of a case occurring in his practice of nervous deafness affecting a father and son.

One of the most common occasional causes is cold, more especially applied to the head uncovered, or by sudden force to the ears; heat from the sun, when the head is exposed, or with but a slight covering, if the system is exhausted, producing *coup de soleil* and deafness, from congestion of the brain. Then we have the reflex influence of convulsions in adults or children, or from apoplexy or paralysis, producing pressure, congestion, inflammation, or atrophy of the seventh pair of nerves or its branches. Then follow direct injuries from falls or blows upon the ear, of a severe character, producing concussion of the nerves. Another prolific cause is the poison of typhus, typhoid, and scarlet fevers; rheumatism, gout, measles, or mumps, intermittent fever, hysteria, epilepsy, and syphilis.

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* Sedgwick on the Influence of Sex in Hereditary Disease, B. and F. Medico-Chirurg. Review.

We have also this form of deafness symptomatic or associated with disorders of the digestive organs. It is likewise the result of old age.

Toynbee classifies the nervous disorders of the ear according to their cause:

"The first class (to which belong those cases where the special nervous apparatus of the organ is alone affected) may be subdivided into diseases arising from—(1) Concussion. (2) The application of cold. (3) Various poisons: as that of typhus, scarlet, or rheumatic fevers, of measles and mumps, of gout, of an accumulation of bile in the blood, and of quinine in large doses.

"And the second (where the brain, conjointly with the ear, seems to be injured), into diseases arising from—(1) Excess of mental excitement. (2) Physical debility."

With regard to the last, Mr. Hinton remarks:

"It is difficult to me to accept *debility*, nervous or otherwise, as in itself a cause of nervous deafness. I do not find that the cases of deafness, which appear to me nervous in their character, occur at all specially in the weak. Nor does my observation show me that among specially weak people defect of hearing is particularly common.

"I have, however, been much struck by the frequency with which the symptoms of a passive nerve lesion—a condition suggesting the idea of a functional paresis—coincides with demonstrable tympanic disorder, past or present.

"There are, however, exceptions to this rule, and not very unfrequently we meet with a gradually increasing inability to hear in persons, especially of the female sex, in whom no traces of physical disorder or mental strain can be discovered.

"It is remarkable how small a mental shock suffices in certain persons to give, as it were, the finishing blow to the power of hearing. One patient, whose hearing was previously weak, found herself almost totally deaf after a quarrel between two relations who both appealed to her; another, on visiting a sister dangerously ill, was told on entering the house that she was dead. She heard the information perfectly, but on reaching an up-stairs room was deaf. In both these cases the affection has continued more or less; but both of them also, when seen by me some years afterwards, showed slight signs of former tympanic disease."*

Case of nervous deafness from mental shock.—The wife of Mr. S., a missionary of the Bible Society of Philadelphia, has been deaf for many years. She is of exceedingly nervous temperament. She says that while a young lady she was suddenly called home from a visit among her relatives on account of the illness of her father. Upon being taken to her room she asked how he was, and hearing no reply, thought he was very ill; and calling the doctor into an adjoining room, asked how her father was. Receiving, as she thought, no reply, she feared the worst, and implored him not to keep her in suspense, but tell her how her father really was; when the doctor laid his hand on her head, and said, "Why, my child, you must be deaf!" And so she was; and has remained hard of hearing ever since, perhaps some twenty years or more.

The following is her own account, sent in September, 1863, with the examination:

"I was what is called a delicate child, but not known to have any nervous affection. I was obliged to earn my own support before I was twelve years old; I therefore led a very sedentary life. I think it was in my sixteenth summer I received some distressing news, which instantly caused almost total deafness. I used remedies to brace my nervous system, and in a few weeks could hear, if spoken to in a louder tone than for ordinary conversation. The following summer I spent several weeks in the country, and a short time at the seashore. My bodily health improved very much, and I gained ten pounds in flesh. My hearing returned; but in a few weeks after my return home it again became bad, and, though I have tried various remedies since, I have never received any permanent benefit. I will be forty-four years of age next December. Ever since I have been hard of hearing I have had noises of some kind in my head, either of a buzzing, ringing, or roaring sound, and can hear best when there is a great noise, as when an organ is playing very loud; I can then hear, though spoken to in a very low tone; and I have often noticed, when riding in an omnibus over the stones, that I could hear conversation better than others whose hearing was good. My not hearing persons when they first speak to me has always had an unfavorable effect, as the very effort to hear seems to make me more deaf. I have been married sixteen years.

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* Mr. Hinton's Supplement to Toynbee, p. 459.

"AMANDA M. S."

Examination.—External meatus natural; membrana tympani good color, slightly milky tint; middle ear, both Eustachian tubes open, but a good deal of mucus accumulation. No treatment was of any permanent benefit.

Frequency of the disease.—Kramer, in his early work, states that out of 2000 patients 1074 were classed as affections of the auditory nerve; now, with the advance in pathological anatomy, especially in the study of exudations, he has reduced the number to 4 in 1000.* In Wilde's table of 2385 cases, only 244 were true cases of "nervous deafness." In the still later table of Triquet, of 163, 46 were truly nervous. Toynbee publishes 200 cases of deafness, and only about 35 or 36 of nervous are given; still, he considers that the "nervous apparatus, which receives the sonorous undulations from the tympanum and conveys them to the brain,—one of the most delicate structures in the human body,—is liable to many functional and organic derangements."

Of some fourteen hundred cases of ear disease, which I have treated in the Howard Hospital and in private practice, I find that the proportion of cases in which there was no lesion of the external or middle ear is about twenty in one thousand.

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* See The Aural Surgery of the Present Day, by Dr. W. Kramer. Translated for the New Sydenham Society.

Influence of sex.—In Kramer's table we find 581 are males and 447 females. In Wilde's the sexes are nearly equal; while Triquet had 18 females and 28 males.

These statistics do not sustain the generally received opinion that females are more affected with nervous deafness than males.

Physiology.—The auditory nerve or portio mollis of the seventh pair has its origin from the medulla oblongata by two roots. The labyrinth receives nerves from no other source than the portio mollis, unless we suppose the portio intermedia to consist of filaments from the facial, which accompany the ramifications of that nerve into that part of the ear.

Mr. Bowman considers that the portio mollis is the nerve of hearing, and that it is abundantly proved by the following arguments:—1. The distribution of the nerve to the internal ear, to which no other nerve of any importance is distributed. 2. Its softness of texture and cribriform character, which distinguish it from ordinary nerves of sensation or motion. 3. Diseased states of it, or of parts immediately near its origin, affect the sense of hearing, whilst a paralytic state of the portio dura or of the fifth does not affect the sense. I do not consider this argument of Mr. Bowman's entirely conclusive, as the accessory nervous apparatus plays a most important and necessary part in this function. We find its analogy in the eye. If the supraorbital branch is cut, vision will often be lost, while the optic is not injured; so also, injury, pressure, inflammation of the branches of the tympanic nerve of Jacobson, from the glosso-pharyngeal, and from the otic ganglion, produce loss of hearing of "nervous character," and only affecting the auditory nerve secondarily, or by reflex action.

The tympanum receives branches from the facial and glosso-pharyngeal, and probably from the sympathetic.

The facial, in its passage through the aqueduct of Fallopius, gives off the chorda tympani, which, according to Mr. Bowman, seems to have no physiological connection with the tympanum or its contents. Yet it has a connection, if we admit, with Arnold, that there is an anastomosis between the acoustic nerve and the nerve of Wrisberg, into which the chorda tympani continues. The chorda tympani passes along the membrana tympani, and if a moderately strong induction current is sent into the ear, the patient will sometimes experience a peculiar sound and a painful sensation of sticking in the ear, and a drawing-together sensation in the anterior half of the tongue. Duchenne, Erdmann, Baierlacher, and other observers have proved that this sensation in the tongue is produced by the galvanic irritation of the chorda tympani, which, passing on the inner side of the membrana tympani, joins, immediately after its exit by the Glaserian fissure, the lingual branch of the fifth. These two nerves do not lie together in one, but are connected by filaments throughout their whole course.

The stapedius muscle also receives a branch from the facial nerve. The anastomosis of Jacobson results from the subdivision of the tympanic branch of the glosso-pharyngeal nerve, which enters the cavity of the tympanum below, and, passing over the promontory, gives off branches to the membranes of the fenestræ and Eustachian tube, and to the otic ganglion.

A branch is described by Arnold as proceeding from the otic ganglion to the tensor tympani muscle.

The external ear is supplied by the facial nerve as regards its muscular apparatus, and by the fifth pair as regards its sentient surfaces.

Pathology.—There exist at present very many indications by which the morbid conditions which have been found on dissection of the nervous structures of the ear may, with some degree of certainty, be connected with symptoms observed during life. Mr. Toynbee found the auditory nerve diseased fifteen times; ten times atrophied, twice with blood effused around it, once suppurating, and once having a tumor attached to it, and once absent. Disease of the labyrinth he observed seventy-three times; most frequently atrophied, thickening, deficient endolymph, excess or deficiency of otoconie, deposits of pigment membranous bands, exostosis, the endolymph opaque or red, or the blood-vessels enlarged.*

"Voltolini found most frequently thickening of the membranous structures, cretaceous deposits, deficiency and excess of otoconie, deposit of pigment, amyloid degeneration of the auditory nerve, once a fibroid tumor in the cupola of the cochlea, and once a sarcoma of the nerve.†

"In Mr. Hinton's dissections he has found more or less decided morbid conditions of the nervous structures by no means very uncommon. Most frequent has been an enlargement and congestion of the vessels of the labyrinth, often of a very extreme degree. This he has observed forty-one times, and chiefly in connection with inflammatory affections of the tympanum. Excluding cases of deaf-dumbness, he has found the membranous labyrinth obviously atrophied sixteen times, soft and swollen ten times, and seeming fatty twice; the endolymph opaque or red seventeen times, seeming too abundant three times, and too scanty twice; the otoconies in apparent excess fives times, and in apparent deficiency eight times; twice the labyrinth has contained pus, and once cholesterine; once the sacculus had undergone bony degeneration; once the lamina spiralis was thickened; once the cochlea contained a fibroid mass, three times an excess of pigment, and twice extravasated blood. The auditory nerve he has seldom found decidedly diseased. Twice the internal meatus was narrowed by bony deposit, and three times the fibres seemed atrophied or softened.

"Of all the appearances observed, the frequency of vascular congestion, and the extreme degree it reaches, without the existence of any symptoms which have commanded attention, seem to him the most important."‡

The late Joseph Toynbee, F.R.S., has made the greatest number of sections of the ear, and states that the occurrence is very rare of caries of the labyrinth, for this reason: that ulceration of the mucous membrane of the tympanum is far from a common disease, while, under the influence of chronic inflammation and of the secretion collected in the tympanum, the membranes both of the fenestra rotunda and ovalis become thickened and turgid. Mr. Toynbee has met with one case in which there was ulceration of the membranous labyrinth; he reports four other cases. In two of them the labyrinth became carious or necrosed, and the dead bone discharged, without the production of any symptoms of cerebral disturbance. The first occurred under the care of Mr. Hinton, in a man aged fifty-five, who suffered from a discharge from the right ear for some years, and at last the cochlea was discharged entire. The second case occurred to Mr. Shaw, in a boy aged seven years, who had suffered from otorrhœa in both ears, following a severe attack of scarlet fever, which he had two years and a half before. He had paralysis of the muscles of the left side of the face; for a year he had been completely deaf in both ears. The greater part of the petrosal portion of the temporal bone, including the meatus auditorius internus and labyrinth, was removed by the forceps, being separated by necrosis. He entered the Middlesex Hospital, July 31st, 1855, and was discharged by the end of September. The ulcer in the tube cicatrized; there was paralysis of the face; deafness, and a trifling discharge from both ears. He left the hospital in good health. In the other cases death resulted, the brain becoming seriously involved.

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* Medico-Chirurgical Transactions, vol. xxxviii.; Toynbee's Catalogue, p. 119.

† Von Tröltsch, Ohrenheilkunde, third edition, p. 385.

‡ Hinton on Nervous Deafness, Guy's Hosp. Rep., 1868.

The following most interesting case, which also recovered, is quoted from Mr. Wilde. He says: "I am indebted to Sir Philip Crampton for an examination of one of the most extraordinary pathological dissections of diseased bone perhaps in existence, consisting of the entire internal ear, cochlea, vestibulum, and semicircular canals, with a small portion of the inner wall of the tympanum, which he drew forth from the meatus of a young lady, who, after the most urgent symptoms of inflammation of the brain, with paralysis of the face and leg, and total deafness of one side, recovered from the head symptoms and the paralysis of the extremities, after a copious discharge from the ear."*

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* The Nature and Treatment of Diseases of the Ear, p. 358.

Let us, with Von Tröltsch, examine the analogous relations in other organs; for instance, that of vision, and, at the same time, study the sources of nutrition, and the mode of development of the inner ear.

"The inner ear is entirely independent of the other portions of the organ of hearing, both as regards its source of nutrition and its development. Its artery, the internal auditory, does not come from the external carotid, as do the vessels which supply the external and middle ear, but from the brain. It comes either directly from the basilar or from the anterior cerebral branch of the latter. There does not appear to be any direct communication between the vessels of the middle and external ear, so that secondary disturbances of nutrition of the labyrinth can only result from alterations in the brain, or from morbid conditions in the interior of cranium, but not from affections of the outer ear, except when both are involved. The process of development also shows the independent character which pertains to the labyrinth from the very beginning. Whilst the tympanic cavity with the Eustachian tube are developed from the bronchial apparatus, or, as Arnold and Von Baer assert, from a process of the pharyngeal mucous membrane, the labyrinth is developed from the ear vesicle of Emmert, or projecting process of the cerebral vesicle. The labyrinth is formed much sooner than the petrous portion of the temporal bone, and its ossification proceeds independently. Even afterwards, the nutrition of the part of the petrous portion of the temporal bone which contains the labyrinth is seen to be independent of that of other parts; and I have mentioned instances of isolated necrosis of this portion. Let us now examine the analogous relations of the eye, and we will find that there, as is well known, the diseases of the retina and optic nerve are far less frequent than affections of the outer coats and refracting media, and yet here the causes for a production of disturbances in the nutrition of the nervous apparatus exist in a far greater degree than they do in the ear. The retina and the entrance of the optic nerve lie in an elastic globe, which is exposed not only to internal but to external influences; the retina is not only connected with the brain, but with the choroid and the vitreous body, whilst the nervous apparatus of the ear is only connected, as regards nutrition, with the brain, and being enveloped in a bed of the hardest bone, and considerably removed from the surface of the body, it is unaffected by any external influence except the severest wounds and concussions.

"It is, therefore, highly probable that primary affections of the labyrinth, or idiopathic 'nervous deafness,' are incomparably less frequent than affections of the outer and middle ear, and that, when secondary, they are most frequently caused by affections of the brain, or by changes in those parts which also belong to the tympanum, and which, as we have seen, give rise to very numerous pathological phenomena, viz., the round and oval windows, which have both a covering of the periosteum of the labyrinth. Abscesses or caries may find their way from without, as we have already said. In no case, however, should the diagnosis 'nervous deafness' be made, unless no change, to which we can attribute the symptoms, can be discovered in those parts which are explorable by our senses. This demands a perfect knowledge of the normal condition of the parts, and a faculty to discern the slightest change,—*e.g.* in the membrana tympani. Many even experienced aurists are deficient in these requisites, and very considerable abnormities in the just-mentioned organ have been overlooked. With regard, then, to the frequency of the diagnosis 'nervous deafness,' we remark, that in all the branches of medicine, the less one's anatomical knowledge and exact research, the oftener one considers diseases as 'nervous;' but the greater one's progress in these two requisites, the more means one has of explaining the symptoms, the less often does one make such a diagnosis, which, as a general rule, is nothing better than a makeshift. The severity of the deafness does not necessarily indicate an affection of the labyrinth; affections of the middle ear may cause the most severe deafness, as observation teaches us."*

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* Von Trōltsch, Anatomie des Ohres, pp. 93, 94, 95.

The nervous apparatus of the ear suffers, as is well known, in many ways from affections occurring during infancy, especially from the morbid conditions associated with convulsions. Considering the severity of the cerebral disturbance often resulting from diseases even of the tympanum alone, especially in children, it seems to be deserving of consideration, whether, in many of the cases in which cerebral disease is supposed to result in deafness, it would not rather be found that disease of the internal ear had induced the symptoms of cerebral disease. Apart from Flourens' experiments—confirmed and extended by the more recent ones of Czermak on doves—on the effects produced by injury to the vestibule and canals, there is evidence of the serious results to the nervous centres which acute disease of these parts involves.

As bearing upon this subject, Mr. Hinton avails himself of Dr. Wilks' kindness to report two cases which were under his care:

"The child of a medical man, aged two, was taken ill on March 9th, with feverish symptoms, etc., and a powder with calomel was given it. On the three following days continued very ill, constantly crying out, as if in pain, and with much febrile disturbance.

"On March 14th Dr. Wilks saw him; found him very ill, very restless, constantly moving about, as if in great pain; skin hot, lips parched, pulse 140. There were no symptoms indicating any cerebral mischief; but the bowels were relaxed, the abdomen full and soft. It was thought, therefore, that his complaint might be dysentery in an early stage, and two grains of Dover's powder were ordered.

"March 19th. Appeared better; had slept, and was quieter. After this, however, the former symptoms reappeared; extreme restlessness, and screaming, as if in pain. There was evidently some source for this, but it was difficult to discover. For a week he thus continued; throwing his head about, as if in pain, but with no other cerebral symptoms; and the child appeared quite sensible. He then passed a lumbricus, and it was hoped that another purge might relieve him, but it had no such effect.

"March 22d. Appeared worse; never quiet for a moment; lying in his nurse's lap, throwing himself about, his arms, legs, and head, as if endeavoring to gain repose from some internal agony. He then began to make curious movements with his mouth, constantly thrusting his tongue out, and licking his lips. For nearly another fortnight the child thus continued; with constant restlessness, throwing his head about, as if in great pain, and placing his hand over his head and face. The father then lanced the gums, but with no effect. About a month after the commencement of his illness, and when the child was wasted to a mere shadow, a discharge occurred, first from one ear and then from the other. For a day or two there appeared no relief; but after this the child began to get better; ceased to cry, took its food, and grew stout. He is at the present time in good health, and his hearing said to be good.

"The case was a difficult one, and no decided opinion could be given during the child's illness; but after the occurrence of the discharge from the ear, it was thought most probable that an acute otitis had been the disease.

"Jas. B., aged twelve, admitted into Guy's Hospital, under Dr. Wilks, January 12th, 1861, with severe cerebral symptoms. He was apprentice to a bootmaker at Peckham. On inquiry being made in reference to injuries, it was said whilst in the workhouse he had often been struck by the master, and he also lately had falls whilst sliding, but it was not known that he had hurt his head. A fortnight before admission he was seized with rigors, vomiting, etc., with febrile symptoms. These continued until two days before he came in, when he became deaf. He was then excessively ill, and in a drowsy state, rolling his head about as if in pain. Was perfectly deaf, the loudest noise not perceived; he was, however, apparently quite sensible. Tongue thickly coated; bowels costive; occasional vomiting. Leeches had been applied to the temples; was ordered calomel, one-half grain every four hours. He continued much the same until the 15th, when purging came on, and the mercury was stopped. After this he slightly improved, and on the 19th he was much better. The febrile symptoms were disappearing, but he was as deaf as ever. He rapidly improved, and on the 31st he had left his bed. On examining the ears, the membrana tympani appeared quite perfect. The boy soon after left. He called upon me about eight months afterwards; he was in good health, but he appeared entirely deaf."

The following case shows somewhat of the subsequent history of a case probably very similar to the last:

"Laura E., aged thirty, healthy, but very nervous. Lost her hearing entirely at about a year old, at which time severe cerebral symptoms set in; the eyes being turned up, and the body stiff for several days; no distinct convulsions; both jugulars are said to have been opened, and mercury was rubbed in. Diarrhœa followed, which seemed to relieve the head, but the hearing was gone. An eminent physician said that if it were recovered it would be at the time of cutting the second molars, and at that time, about the age of seven, there came on a slight perception of sound. She was then again treated with mercury, which is supposed to have induced a nervous weakness, without result on the hearing. She appears now totally deaf in the right ear; the left very gradually advanced till about the age of twenty, and with it and the aid of the eyes she can understand short sentences, but cannot repeat numbers shouted into her ear; distinguishes sounds by the quality of the vibration,—*e.g.* she perceives thunder in the head, guns in the feet. She felt the explosion at Hounslow, some years back, at a distance of fifteen miles, when no one else in the neighborhood was aware of it. Some tinnitus; does not hear better in a noise. It is said that she heard (comparatively) well on the mountains in Switzerland. Throat healthy.

"Meatus narrow; each membrana tympani bright; inflates left with a slight moist sound, not right. The right Eustachian tube being closed, it was in two or three sittings gently made pervious. No change ensued."

"This is an example of very many cases, and, in respect to some at least of them, is it not natural to doubt whether an affection of the brain, or its membranes, of so severe a character, could have passed away entirely, leaving no effects except an almost total abolition of the function of the auditory nerve? What should induce so exact a limitation of an inflammation affecting parts in absolute continuity? Would it not be more reasonable to suppose an inflammation, possibly beginning in the tympanum, and, by extension inward, involving the vestibule and cochlea?—a result which might well have ensued in the first case mentioned by Dr. Wilks, if the membrana tympani on each side had not given way. It is not uncommon to find inflammatory affections of the tympanum inducing abscess in the cerebral substance without disease of the intervening parts,—the bone and dura mater being in no visible way affected. Is it at all improbable that a parallel extension of morbid action might take place in respect to the nearer and more closely related labyrinth? I am the more persuaded that the causation of the symptoms, in some of these cases, is that here suggested, because I have, in the dissection of the ears of deaf mutes, met with appearances in the vestibule that seemed indicative of former inflammatory action, especially a roughness and contraction of the first turn of the cochlea at its junction with the vestibule.

"It is not only in this extreme form, however, that deafness results from apparent 'cerebral' affections in childhood."

"Among the multitude of children who apply for assistance, in consequence of disease of the tympanum, or Eustachian tube, there occurs every now and then a case which, on a hasty examination, would pass as an ordinary one, but would be sure in time to arrest the surgeon's attention by its refusal to take the ordinary course. Remedies do not tell. Perhaps the Eustachian tubes are obstructed, but opening them has little effect; if the membranes are perforated, the condition of the exposed mucous lining of the tympanum may be improved, but the hearing does not advance. Then, perhaps, it begins to be noticed that the child has a peculiar, inexpressive look, unlike both the keen inquisitiveness of the congenital deaf mute and the self-absorbed restlessness of the imbecile; and, on testing more minutely, it is found that the tuning-fork is very badly heard, and that, so far as can be elicited from children, the other symptoms of a nerve affection are present. In these cases it is often found, on inquiry, that there have been, probably some years before, more or less defined convulsive or 'cerebral' attacks. For the most part these attacks seem to occur during the first two or three years of life. Sometimes, however, they are deferred to a somewhat later period."*

In view of numerous clinical observations, there is no doubt that nervous deafness results from "cerebro-spinal meningitis."

Symptoms.—In forty-six cases of nervous deafness reported by Triquet,† the symptoms may be summed up:

1. *Anatomical symptoms.*—The pavilions and external meatus were found healthy forty-five times. In one case there was a slight serous exudation, indicating some catarrhal complication. In twelve cases the membrana tympani had lost their usual transparency. They were cloudy; and in one case the membrana tympani had a parchment-like aspect. In twenty-two cases cerumen was found in the meatus in more or less noticeable quantity, of good consistency, and the color and appearance of honey. The Eustachian tubes were found healthy and free in forty-six cases.

2. *Physiological symptoms.*—The initial deafness has always been considerable. In twenty-seven cases the patients could not hear the watch, when in contact, at the commencement of the treatment; and in the remaining nineteen cases eleven patients heard the watch only when in contact; and in eight others the watch was heard at a distance of from four to ten centimetres, on an average.

Of over forty-six patients, nineteen had deep-toned intra-aural sounds; four had shrill-toned sounds or whistlings; one patient had strange sounds without any indication; and twelve had no intra-aural sounds.

Erethismus of the ear is noted eleven times; twice it was very marked, and nine times it was completely wanting. There is no mention made of it in the other thirty-five cases. Headache has been noted twenty-four times. Paracousie, cophosis or double hearing, is noted only twice. The senile circle existed in all the cases, in a degree more or less marked.

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* Hinton, Guy's Hosp. Rep., Third Series, vol. xiii.

† Traité Pratique des Maladies de l'Oreille, p. 449.

DISSONANCE OF THE ORGANS OF CORTI.*

"The dissonance of the organs of Corti may have reference to a single or to a whole succession of tones; it may be transient or permanent.

"It has hitherto been observed in diseases of tympanic origin, in severe concussion of the labyrinth; and it may result from a blow upon the ear, or intensity of sound, and also by influences acting upon the whole nervous system. From these general observations we will, in proceeding, mention the special cases or facts in historical order.

DOUBLE HEARING (PARACUSIS DUPLICATA).

"Under the head of derangements of the organs of Corti, we find, as longest known, that of double hearing, which affects the hearing of both ears as well as that of one only.†

Sauvages‡ relates a case of double hearing, which developed itself in consequence of a catarrh, and with it disappeared. Itard treated a woman who was troubled with intermittent deafness; whenever the hearing returned again, the patient heard all sounds double.

"Von Gumpert observed in himself a paracusis duplicata monauricularis. Here, the symptom appeared to present itself, after inflammation of the ear, the origin of which could not be anatomically located. The variation in tone fluctuated between a *third*, a *fourth*, and an *octave*. Von G. could distinguish both tones; the deeper tone appearing close to him, the higher at a distance of two or three yards from the diseased ear. Von Gumpert also observed in himself a double hearing of words. These phenomena, which, during the whole continuation of the disorder, were at no time accompanied by ringing, whizzing, or rushing in the ear, continued for eight days without interruption, and seemingly disappeared after dropping in *oleum hyoscyamus coctum.**

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* Klinik der Ohrenkrankheiten, von Dr. S. Moos. Wien, 1866, pp. 319, 320.

† This is termed by Prof. Knapp "diplacusis binauricularis," in analogy with "diplopia binocularis." See Hemholtz's Theory, p. 40.

‡ Bressler, Die Krankheiten des Kopfes und der Sinnesorgane. Berlin, 1840, Bd. ii. s. 375.

"For an accurate personal examination of these symptoms, made four weeks after a severe purulent inflammation of the middle ears, we are indebted to Von Wittich.†

"The tone of a tuning-fork struck the disordered ear at exactly a half-tone higher than the sound ear, and so with all the moderately high tones; when the third octave was whistled with the mouth, or struck upon the piano, it was heard doubled, with a difference of half a tone. These experiments continued the same, whether the outer auditory passages of the diseased ears were filled with wadding, or water, or otherwise rendered tense through pressure of air on the drum of the tympanum. A tuning-fork placed on the teeth, produced first the natural tone, and then by degrees the next half-tone was heard ringing; if placed upon the forehead, the tone became a half-tone higher, increasing as it neared the disordered ear.

"With two tuning-forks, one of which gave a half-tone higher than the other, only one tone was heard with both ears when the higher was sounded near the healthy ear, and the lower near the diseased ear.

"If the organs of Corti, through their really peculiar arrangement of fibres, bring about the sensation of a tone of fixed number of vibrations and continuance, it is accountable how another tone becomes apparent through exudation in the cavity of the tympanum, and through a thereby altered pressure of the fluid of the labyrinth on the nerve filament. So that for the tone *a*, the filament for *b* sounds, whilst when *b* was struck, the filament *a* was vibrated.

"These explanations of Wittich's may be adopted for all those disorders of the organs of Corti which belong to the diseases of the middle ear.

"So, also, in the following case: A celebrated tenor consulted me, because, fourteen days after a violent cold, he was troubled with a symptom which completely interrupted him in the exercise of his calling. The patient said that he heard the third of every note he sang at the same time. Examination showed as the cause a simple catarrh of the middle ear, with considerable deafness of both sides. After nine applications of the catheter, together with injections of ammoniæ murias, — ten grains to half a fluidounce, — the patient was completely cured."

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* Made by boiling the fresh leaves of the hyoscyamus in olive oil.

† A case of double hearing observed in himself. Königsberg Medical Chronicle, vol. iii. pp. 40–45.

In other cases the theory of Wittich's was not so applicable; for example:

"V. S., an officer, sixty years old, very musically inclined, for four years visited the sea-shore, on account of emphysema of the lung. Since that time he suffered under a gradually increasing deafness. This had developed itself entirely without pain, beginning with a rushing sound on both sides, which had lately ceased. Of late years the patient had suffered much from catarrhal complaints of throat and chest, and especially a tolerably severe asthma.

"The examination showed a considerable amount of epithelial scales in both external ears, extending pretty well into the tympanic membrane, and spread from the centre to the circumference, as also a strongly marked circular, muddy margin. Injection of the vessels of the handle of the malleus; dullness of the light spot. The tubes of both sides are slightly pervious; catarrh of pharynx. Understands conversation two and a half paces to the right, one foot to the left. The watch at six feet is not heard at all (also when applied directly to the bones). After three weeks' treatment, the patient was able to hear low muffled sounds for more than thirty-six feet from him,—end of August, 1863, dismissed.

"On the 14th of May, 1864, the patient appeared again, and reported as follows: 'About a month after, at an evening musical entertainment at my house, I had a pretty violent attack of asthma. I went into another room, in order to relieve the attack as quickly as possible by means of the inhalation of chloroform. Directly after the narcosis I was much deafer; it came on with various strange noises, upon both sides, and I heard all tones above the first *a* struck doubled; at present, however, it is the second *e* struck doubled, and all octaves from that on.' Found the patient much worse as to hearing. Could now distinguish only very loud conversation at the length of one room and a half to the right, and the length of one room to the left. A watch, distinguishable at twenty-five to thirty feet, was heard two inches to the right, and only in contact on the left side. His perception of sounds now gradually became worse, and on the 21st of April, 1865, he could hear only loud conversation at one to two paces from him, on both sides, and the watch, on contact, on both sides.

"All musical tones were heard false and confused; and music, for which the patient had before entertained such liking, is now an abomination to him.

"The dissonance of the organs of Corti may not be considered in this case as a secondary disorder, brought about or dependent upon a chronic process of inflammation in the tympanum.

"We must suppose rather that as the former had already existed ten years, in consequence of the narcotic effects of the chloroform, sudden changes in the labyrinth arose, which caused the double hearing; the nature of which changes it is difficult to determine."

Diagnosis of nervous deafness.—To arrive at a correct diagnosis, we must first examine with care the auricle, external meatus, membrana tympani, handle of the malleus, so as to discover any change in color or form from that found in a perfectly normal ear. Then follow in order the throat, uvula, and tonsils, and the Eustachian tube, passing air through it with the aid of the catheter and explorer, with the otoscope to determine the internal condition of the tube. Rhinoscopy should also be practiced to examine the condition of the orifice of the Eustachian tube, and in some cases may be available to determine whether the Eustachian catheter has actually been introduced. Then we take into consideration the diseases of the labyrinth, namely, acute and chronic inflammation, with inflammation of the facial nerve within the Fallopian canal and obscure affections of the brain. In this manner we reduce the actual number of apparent affections of the inner ear to which deafness may be attributed.

"Erhard in Germany, and Bonnafont in France, give the preference over this objective diagnosis of nervous deafness to a functional subjective. Thus, according to Erhard, 'the common physiologico-pathological symptom of all nervous deafness is a lessened conduction (of sound) by the bones of the head, varying in degree, so that a cylinder watch is not heard, and a case watch only seldom, and then only feebly.' The uncertainty is further increased by the declaration, that the 'sound-conducting power of the bones of the head is lessened with age, and also by a thick diploë, a thick scalp and soft parts;' that finally, 'those persons only can be determined to be affected with nervous deafness whose conducting power of the bones of the head is deficient, and who are under forty years of age.'

"Bonnafont is still better satisfied with his means of diagnosis, for he believes, and takes credit to himself for having made a new and great diagnostic discovery, 'that the sensibility of the auditory nerve must be perfectly normal if the watch is heard on all parts of the cranium;' and 'when the watch is heard only at the mastoid and zygomatic process, the hardness of hearing is still curable; if the watch is heard nowhere on the skull, but the tuning-fork (at the third octave) is heard five centimetres from the ear, or at least at any point of the skull to which it may be applied, he considers the curability of the hardness of hearing as very doubtful; finally, if the tuning-fork is heard only a short distance from the ear, or when applied to the skull, the incurability of the functional disturbance of the ear cannot be doubted.' Here again arises the difficulty that the patients themselves must determine whether they hear or do not hear the watch or tuning-fork."*

Mr. Hinton, surgeon aurist of Guy's Hospital,† has published a selection of twenty-three cases, from which we have availed ourself of some affections classed as "nervous deafness," and gives the following signs by which any given case of deafness may be inferred to depend upon a disease of the nervous system:

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* Von Tröltsch, op. cit.

† Guy's Hospital Reports, Third Series, vol. xiii. 1868, p. 152.

"1. *The history.*—This is in many cases of itself decisive, especially when it connects the defect of hearing with other nervous derangements. The history, however, may be very misleading if too much relied upon; some of the most marked forms of nervous deafness, especially those of sudden origin, being liable to be closely simulated by simple mechanical obstructions. Among the most frequent causes of nerve-deafness, besides blows on the head and the effect of extremely loud or long-continued noises, are fever, sunstroke, mumps, diphtheria, parturition, prolonged residence in India. Convulsions in childhood stand as the origin of many cases, but it is a question whether, in a large proportion of these, the convulsive seizures have not been an effect of the ear disease.

"2. Certain peculiarities of the hearing; such as the hearing better in a noise (as when riding), or hearing worse on excitement, depression or fatigue, or on any special attempt to listen. A much better hearing for some sounds than for others, as for example, for the watch as compared with the voice, is a suspicious circumstance; so also is a great diminution. It might have been supposed (inasmuch as we hear our own voice partly through the cranial bones, and its resonance is decidedly increased by closure of the meatus) that some value might be attached to the patient's own manner of speaking, whether loud or low; since this seems to depend mainly on the degree in which his voice is heard. But though as a rule, at least in the more recent and less extreme cases, this supposition seems to hold good, there are too many exceptions to allow it any practical value. Many patients with recent tympanic deafness complain that their own voice sounds loud to them; and the loud and harsh sounds uttered by deaf mutes is an extreme instance of the tendency to raise the voice in those whose nervous faculty of hearing begins to fail.

"3. A certain value is attached to the degree of deafness, which if it be very excessive cannot depend on absence of conduction; but it is difficult to draw the line.

"It seems certain that disease of the conducting apparatus may reduce the hearing to a lower pitch than its congenital absence necessarily involves.

"4. Certain tests can be applied to the hearing by means of a tuning-fork placed on the head, which will sometimes give almost or quite decisive information. Little value can be attached to the mere fact that a tuning-fork of any particular pitch is heard badly, or even not at all, through the cranial bones, since not only do various diseases of the tympanum produce this effect, but I have known at least one person, with healthy ears and perfect hearing for the voice, entirely unable to hear a tuning-fork upon the head. But since this peculiarity is rare, an inability to hear vibrations thus imparted to the cranial bones may be fairly held as a suspicious circumstance, and at least the converse may be held valid that, if the tuning-fork be well heard, the deafness is not likely to be nervous. But the chief use of the tuning-fork in diagnosis rests on the simple fact that its vibrations, when imparted to the bones, *pass outward* freely through the tympanum and external meatus, and are therefore reinforced by reflection when either the tympanum or the meatus is rendered impervious to sound. If the meatus of a healthy ear be closed by the finger, the sound of a tuning-fork placed on the head becomes louder, and the same is the case with sounds produced by our own vocal organs, when the mouth is closed, the escaping vibrations being thrown back upon the labyrinth.

"If the meatus be obstructed by wax, the ear being otherwise healthy, the effect is the same; or, again, if the passage of vibrations through the tympanum be hindered by closure of the Eustachian tube. It may, indeed, be laid down as fairly ascertained that whatever diminishes the permeability of the tympanum or meatus for sonorous vibrations, causes the bone-conducted sounds to be, *cæteris paribus*, better heard. If, therefore, a patient comes to us deaf on one side only, we have at hand an immediate means of determining, with an extreme degree of probability, the seat of the disease. We place a tuning-fork upon his head, and inquire on which side it is best heard, of course being careful not to accept a hasty answer. Generally it will be found loudest on the deafer side, the conducting media being most often in fault. If it is heard best, or only, by the better ear, the nervous system is in some way concerned in the deafness. It often happens, however, that no decisive information can be obtained in this way, the tuning-fork not being heard unequally on the two sides, although the condition of the ears may be very different. This may be accounted for in many ways, such as inaptness of the patient to discern, or a balancing of morbid conditions producing opposite effects in the ear itself.

"Of course, when both ears are pretty equally involved, this method is not applicable.

"But in all cases the effect of closing the meatus by the finger, while the tuning-fork is placed upon the head, gives important information. If the conducting media are healthy, the sound is rendered louder by the closure; if they are impermeable to vibrations, no effect is produced."*

Prognosis.—The prognosis is generally unfavorable; still, there are cases which are improved by a rational mode of treatment; but it must be borne in mind that nervous deafness is a symptom which may arise from many different lesions, and that, consequently, the same means of treatment, blindly or empirically followed, cannot be applicable in all cases.

ILLUSTRATIVE CASES OF NERVOUS DEAFNESS ARISING FROM CONCUSSION.

"B. H., aged forty-four, from a boy thinks his hearing was not sharp, though it was good enough for all purposes, and he never had any disease of the ears. At the age of twenty-two, being then in perfect health and in possession of all his faculties, he was about to call on the parents of the lady who afterwards became his wife; but on the morning of the proposed visit he woke up almost entirely deaf; 'they could not make him hear anything,' he said. He had neither pain nor noise in the ears, but there was a stuffy feeling in them, for which they were shortly [illegible] syringed, with no effect. He had gone to [illegible] In about a week he began to improve, [illegible] in a month; but about two years af[illegible]

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by defective hearing, chiefly on the right side, which, within the last two or three years, has become worse. There has been all the while an occasional singing in the ears, mostly in the right.

"He was a perfectly healthy man, of fair complexion; his hair had turned gray within the last two years. His health had always been good; four or five years ago he had been depressed about business, and suffered much from his throat, but was not then more deaf; now finds himself made much worse by any excitement, especially of an annoying kind; no members of his family are deaf; there is some tendency to gout, but he never had an attack of it. He is moderate in his habits, and a great walker, though lately he has become rather stout. Is more deaf after dinner, or after wine. Does not hear better in a noise. Is a great sportsman.

"My watch was heard on the right side only on contact with the meatus; on the left at two inches. The tuning-fork placed on the head was heard very imperfectly, and less on the right side than the left. The right membrana tympani appeared perfectly healthy; the left, the better ear, was slightly white. He inflated each tympanum with ease, diminishing for the time the hearing of the watch.

"Thus far the symptoms appeared to me entirely un accountable. Unquestionably we all of us in our turn have felt, or may hope to feel, happily nervous under circumstances like my patient's. But growing stone deaf under them, unless it be to an unfavorable reply, is a phenomenon which pathology refuses to accept. But on carrying my inquiries further, I ascertained that at the age of eighteen (four years, therefore, before the access of the sudden deafness) he had fallen a distance of twenty feet down the stairs of his college, and cut the vertex severely. He was ill for some time after, and the right pupil was dilated at the time, but neither his eyesight nor his hearing was affected. The right pupil is still somewhat larger than the left, but reacts well to light.

"It appeared to me that this circumstance probably contained the key of the case, and that the deafness was due primarily, and in chief degree, to the apparently innocuous concussion, and only in a minor way to the nervous excitement which seemed to be its cause. The supposition is, that the fall—a cause which so frequently jars the auditory nervous apparatus into an almost complete paralysis—had in this case jarred it into a condition of extreme liability to this condition. Other cases that I have met with seem to justify this influence. A butcher's boy applied in May, 1864, suffering from a high degree of deafness, of a month's duration, with no apparent disease of the organ. He had been thrown out of a cart a week before the hearing became impaired. Another case may be worth reporting more in detail.

"Mary B., a healthy woman, aged thirty-six, single, applied at Guy's Hospital, in April, 1864, on account of deafness, which was almost complete. Four years ago she had fallen down-stairs and struck the back of her head. She was insensible for several days, and on recovering consciousness, found herself quite deaf on the left side, and very considerably so on the right. After three or four months the hearing began to return in the right ear, and soon became moderately good. Loud sounds, however, were painful and confusing to her, and she would become more deaf during a cold, or if excited or worried. The fall also destroyed the sense of smell.

"This condition continued upward of three years, until eight weeks ago, when, after returning from a walk during hot weather, but unattended with fatigue, she became again suddenly deaf in the right ear. Nothing had occurred to agitate her beyond a pleasing invitation. She had worked and stooped more than usual a fortnight before, and the day before, after riding in a cab, had felt somewhat sick. At the time of becoming deaf she had pain in the head. Leeches and blisters had been applied, and medicine given, which produced 'twitchings;' she had been galvanized also without result. She complained of tinnitus, like bells or a piano, in both ears. This had previously existed on the left side only. She was unable to repeat words shouted into her ear. The tympana, so far as could be ascertained, were perfectly healthy. Eighteen months afterwards she had become entirely deaf. Tinnitus less; health good. Each membrane was natural in appearance, except a little whiteness at the upper and posterior parts. Other cases also I have met with in which deafness caused by a blow on the head has ceased for a time and suddenly returned."*

Rev. J. M. H., a missionary, aged fifty-nine. First had symptoms of dullness of hearing in August, 1859. In trying to mark out a window in a chapel which he was building in Birmah, put a chair on a table, and in stepping back, forgot that the chair was not on the floor, and fell, making a clean cut on the occiput. The wound healed very quickly, having been dressed by a native with adhesive strips. The sensation in the head was like a bowl of jelly. Having frequent headaches afterwards, the pain all centred in that spot. Over a year after the fall, the deafness was noticed, and gradually becoming complete, with paralysis agitans.

In 1861 and 1862, he could not hear the voices of his family. He used instruments in 1863: first a gutta-percha tube, from England, which did him no good. Hears his own voice perfectly. The trumpet he now uses is the form illustrated in article under Fig. 14, Hearing-Trumpets, and is one of the best forms for such cases. No treatment was of any avail. All parts of the ear were apparently healthy.

There is a variety of nervous deafness arising from compression of the auditory nerve in the internal ear. There is severe and constant headache, vertigo; noises of various kinds within the ear; impaired sight, with or without weakness of the mental faculties, especially of the memory, etc.

Another form is from *cold and its consequences*.—R. W., aged sixty-two, foreman in a large factory, was very much exposed during the winter (1859), contracting repeated attacks of ordinary catarrh, which left him deaf, with no pain. He could hear my watch, indistinctly, close to the left ear; close to the right, rather better; but ordinary conversation in a room he could not hear. He has had a constant humming sound, like that of a saw- or planing-mill, in his ear. No member of his family is deaf; his general health is good.

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* Hinton, Guy's Hosp. Rep., xiii. p. 152.

Examination.—The external meatus normal; membrana tympani natural form; the handle of the malleus is readily seen; the Eustachian tubes free. On shutting the nose and mouth, and making the effort to swallow, the air is found by means of the otoscope to strike upon the membrana tympani in the middle ear.

In this case a great variety of treatment had been tried, but without benefit.

The following case is that of an intelligent and well-educated physician, in active practice, who consulted me in June, 1862. The only change from the normal condition of his ear was a slight opacity of the membrana tympani. He had consulted almost every distinguished physician and surgeon in this country, but without receiving any benefit. "My history," he writes, "briefly stated, runs thus: when twelve or fourteen years of age, I had typhoid fever, was very low; lay six months; after which I have never been robust. From eighteen to twenty-six I was troubled greatly with dyspepsia for several years; much annoyed at times with general headache; took cold easily, which almost always affected my head. In the summer of 1851 I suffered much with dyspeptic constipation, with headache and a sense of fullness, with great thirst, etc. In October of the same year I had a severe attack of congestion of the brain. In February or March of 1852, soon after a full dinner, while sitting in my room, an unpleasant sensation came into my right ear. The next day I had some ice-cold water poured into my ear, which produced severe pain for a moment, but since then I have never had but very slight pain in the ear. In the summer of 1859 I experienced a similar feeling, as above described, in my left ear; to either I have applied nothing except the water spoken of. I have done nothing by any other medical treatment, except to use for about two months a mixture composed of—

℞.—Hydrarg. Bichloridi, gr. ss;
Potassii Iodidi, ℈ij;
Syr. Sarsap. Comp.,
Aquæ, āā f℥iij. M.

Sig. A dessertspoonful one-half hour after breakfast and supper.

With the occasional use of a mild laxative to keep the bowels open.

"In 1860 and 1861 I threw aside tobacco and coffee; both seemed to increase my difficulty of hearing, and also increased the pain in the head."

NERVOUS DEAFNESS PRODUCED BY THE ACTION OF MORBID POISONS.

Syphilis.—The following cases will illustrate this class. The first was seen in consultation with Dr. Condie, and the other is taken from Hutchinson.*

John A. McC., aged thirty-two, a bookbinder, of good general health, but almost totally deaf in both ears; born in the United States; mother living and well; no other member of the family deaf. His deafness commenced in the left ear, and, according to the statement of his physician, he had secondary syphilis about this time, was treated by specific remedies for it, and recovered from all the symptoms but the deafness, which increased, eventually extending to the other ear. Has ringing in the ear, as if he had just heard the loud report of a cannon. No pain in head or ear.

Examination.—Cannot hear my watch in contact with his ear, or over his mastoid process; but if I place it upon a board, with his face down upon it, he can hear it; he also can hear at times the clock strike in the room, also the sound of cars or wagons in the street. External meatus of right ear normal; left ear narrowed. Some one, he states, advised the use of water of ammonia dropped into this ear, after he had become deaf, which caused a discharge and narrowing of the meatus, slight opacity in both membrana tympani, and greater dryness than natural. The Eustachian tubes pervious. There is not disease sufficient to account for the state of extreme deafness. The throat red and inflamed; tonsils very much reduced in size. It is now some two years, and although Dr. C. has tried both specific and other treatment, no improvement has resulted.

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* A Clinical Memoir on Certain Diseases of the Eye and Ear consequent on Inherited Syphilis, by Jonathan Hutchinson, F.R.C.S. London: John Churchill, 1863, pp. 182, 183.

"Susan S., aged thirteen, aspect of syphilis fairly marked, and teeth characteristic, converging toward each other, very short, with a vertical notch or cleft in their free edges, not being so wide there as at their necks. Numerous white deposits of long standing in both corneæ. Both pupils notched, and irregular when dilated with atropine. Nine brothers and sisters are living, none have died. The patient is the third in family, the two elder ones being girls; one of the elder ones has had inflamed eyes.

"She began to lose her hearing in February, 1861. There was no discharge, and not any material earache. She was very much troubled with noises and singing in her ears. The left was rather the worse, but both were affected. She can now just hear a watch pressed over her right ear, but cannot hear it on the left. The ear is dry internally, but there is no other peculiarity visible. The tonsils are not enlarged.

"*General comments.*—It will be seen that all the cases reported by Dr. Jonathan Hutchinson (twenty-one in number), in which the ears were inspected, support the belief that the deafness of syphilitic children is due either to disease of the nerve itself, or to some changes in non-accessible parts of the auditory apparatus. Its symmetry in all the cases would point to a central cause. In none were there found adequate changes in the membrana tympani, although in none was that membrane quite normal. In all the Eustachian tubes were pervious: my belief, therefore, is that the deafness in these cases is due either to disease of the nerves or of their distribution in the labyrinth. These cases constitute the analogues of syphilitic retinitis and of white atrophy of the optic nerves."*

Gout.—The poison of gout may also give rise to nervous deafness and other peculiar symptoms in the head.

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* In confirmation of Dr. Hutchinson's observations, Prof. Jos. Gruber has found, in a post-mortem examination of a soldier who died from typhus fever while laboring under syphilitic deafness, there was considerable hyperæmia of the mucous membrane of the drum, and the membranous labyrinth appeared much thickened. The liquid within the labyrinth was sanguinolent and abundant. (Lehrbuch der Ohrenheilkunde. Wien, 1870, p. 617.)

"*Presumed immobility of the stapes from gout.*—A. M., aged thirty, a healthy man, has been gradually becoming deaf for ten or twelve years. For about two years the deafness has caused him inconvenience; never any pain in the ears, nor tinnitus; does not hear better in a noise; is worse after a hearty meal, or during a cold, if severe. Smokes three or four pipes daily; has traveled much by rail. No relatives deaf; there is much gout in his father's family, but he never had any symptom of it; sight good; throat slightly relaxed.

"Watch, each ear, seven inches; heard also on the forehead; tuning-fork well heard, sounding a little louder on the right side; no effect from closing either meatus. Right meatus dry; membrana tympani bright, of natural curve; somewhat milky posteriorly. Left meatus contained several loose flakes of epidermis; membrana tympani concave, irregular, and its surface rough. Could inflate the right tympanum, not the left. By means of the catheter the left Eustachian tube was opened, so that he inflated both tympana, which had at first no effect upon the hearing; subsequently it appeared somewhat to diminish it. When air was thus forced into the tympanum the malleus was not seen to move, but on each side the membrane yielded very freely at the upper and posterior part.

"*Presumed affection of the auditory nerve from gout.*—Miss N., aged fifty-two, of languid and worn appearance, had been affected for three or four years with a noise as of rushing water in the right ear, and for about six months with a similar sound in the left ear, but much more intense. It is constant, and occasions her great distress; at times a sudden whistle, like that of a steam-engine, will come in each ear, especially the left, and last a few seconds. During the same period her hearing also has become impaired. No cause has been observed, except that she has long suffered much from severe pains in the head, which begin generally from the right eye, affecting only half of the head at a time, but involving both sides before they leave her. These return regularly every four or five weeks. The deafness and tinnitus are somewhat worse during the attacks. Two years ago she had smallpox, which left her weak, but did not affect the ears. There is gout on both sides, and she has had slight attacks of it in the knuckles. No relatives deaf.

"Watch, right, four inches; left, contact; tuning-fork not well heard; louder on the *right* (the better) side; closing either meatus increases the sound; membrana tympani bright and natural; Eustachian tubes pervious; throat healthy; inflation of the tympanum produced a slight temporary improvement of hearing for the watch, and exhaustion of air from the meatus gave a little relief for the moment to the tinnitus.

"Probably in both of these cases, in spite of their difference, the gouty diathesis was a chief element.*

"*Distressing sensations produced in the ears by gout.*—D. T., Esq., aged fifty-four, consulted me in June, 1857. He said that for the last four or five years he had been subject to attacks of gout, which had at times caused him great inconvenience, and the disease had recently made so much progress as to make him fearful that his brain was weakened by its influence. He added that he was never really clear-headed, excepting just after an attack of gout, when he supposed his blood was temporarily freed from the poison. He had rapidly aged in the course of the previous two years. An extremely distressing symptom had lately presented itself in the form of a peculiar sensation of vacancy in the ears, accompanied sometimes by a low humming sound. There was no deafness, and the patient applied to me only on account of the sensations in the ear. On examination, small deposits of gouty matter were observed in the substance of the right upper eyelid, the surface of the meatus externus was of a bright red color, the circumference of the membrana tympani was red, and there was congestion of the long process of the malleus, while the surface of the tympanic cavity was very bright, air passed freely, and with the natural sound, into it. The hearing power was perfect. By what, therefore, could the distressing symptoms be caused? Were they the result of congestion of the nerve? —a condition which, it seemed to me probable, might render the nerve so exquisitely sensitive that the ordinary sounds ever floating in the air might become a source of excitement to the ear. Being aware, also, from previous experience in similar cases, that pressure on the external meatus, so as to shut out or diminish the sound in the meatus, would remove the symptom complained of, I closed with my fingers each external meatus, and the unpleasant symptoms at once disappeared. On subsequently exerting a gentle pressure on the ears, by the introduction of cotton steeped in water into each, the patient was enabled to leave in comparative comfort. For the purpose of preventing the recurrence of the symptoms, it was, of course, requisite to diminish the congestion, for which purpose two leeches were applied below each ear, small doses of colchicum administered, and strict attention to diet enjoined. The quantity of wine was decreased from four to two glasses daily, and in lieu of beef and mutton, of which he had been in the habit of partaking very abundantly, he was ordered to live principally on poultry, game, and fish, with abundance of farinaceous food and vegetables. The result of this treatment was the removal of the distressing symptoms in the ears, and the gradual disappearance of the attacks of gout.*

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* Hinton, Guy's Hosp. Rep.

"D. W., aged fifty, was sent to Mr. Hinton, in November, 1865, by Mr. Paget, under whose care he had long been, 'with various symptoms of *disorder* of his nervous system, with chronic catarrh of the bladder.' He had always been delicate, but had never had syphilis, nor gone to any excess. First noticed himself a little deaf about fifteen years ago, shortly after a box on the ear from one of his children. A singing tinnitus, now constant, has existed about the same time. Left ear always the worst. Some treatment was early tried in vain, and the deafness continued about the same until three weeks ago, when, without any cause, he became very much more deaf in the course of two or three days. He had been troubled with giddiness for a few weeks previously, which has latterly been worse. His manner was that of extreme nervousness, and his study of his own symptoms amounted almost to hypochondria. Family healthy; has had no gout; but Mr. Paget having thought he observed indications of a gouty tendency, he has found, on inquiry, that his mother's father suffered from it. Four or five years ago, while hunting, he had an attack of double vision, being otherwise well. Mr. Bowman pronounced the eyes right, but that the nerves did not act in unison. This passed off in two or three weeks, but returned about a year ago, and has continued since at intervals, when the eyes are directed to the side; has muscæ occasionally; sees well by each eye with a glass. The right pupil is somewhat larger than the left. No albuminuria.

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* See case of F. S., p. 161.

"He required a raised voice on the right side; on the left could just repeat a monosyllable shouted into the ear. A loud watch was not heard, nor an ordinary tuning-fork placed on the head, except when the right meatus was closed. Right membrana tympani thick, and somewhat concave; redness along the malleus; left, thick, rigid appearance, decidedly too concave, and drawn inward. The right Eustachian tube was pervious, and inflating the tympanum somewhat dulled the hearing. The left tube was closed.

"Although, from the history of the case, the nervous constitution of the patient, and the fact that the tuning-fork placed on the vertex was heard on the right side only, it was considered very doubtful whether any improvement to hearing would result from restoring the perviousness of the left Eustachian tube, it was held right to attempt it, not only on account of the deafness, but also with a view of removing a possible cause of nervous irritation in the pressure on the labyrinth, which exclusion of air from the tympanum seems to involve. The obstruction proved to be considerable, but by the aid of bougies the tube was rendered pervious in the course of a month, so that he could freely inflate the tympanum, the membrana tympani yielding with a jerk before the air, and resuming a natural appearance. A good deal of mucus was withdrawn from the region of the tube, and warm iodine vapor injected a few times. The hearing seemed at times improved, but ultimately remained about as at first, and the proceeding was considered a failure. In about a week, however, the hearing began to improve, and in the course of two months it became, without further treatment, in both ears as good as it had been before the last access of deafness.

"In this case, also, there existed both tympanic and nerve disease; and it is an example of a very numerous, if not the most numerous, class of nervous affections of the ear. As a rule, these coincide, so far as my observation extends, with disorder more or less considerable, of the conducting apparatus; and in this fact, scarcely less than in the difficulty of the exploration of the organ, it seems probable to me, is to be found a reason for the great differences of opinion that have existed as to the comparative frequency of affections of the labyrinth and auditory nerve; and in part, also, the doubt which envelops their causes and their nature. It is not always easy, in any case in which the history does not at once vouch for the seat of the disease, to convince one's self that it lies beyond the tympanum, certain affections of which, such as anchylosis of the stapes, may give no visible indication whatever of their presence, but it has been doubly hard to detect a nervous defect through, and in spite of, a disordered conducting apparatus. Even the advance of diagnostic knowledge, revealing morbid conditions of the tympanum before undetected, has tended thus, in some degree, and for a time, to mislead."*

"*Noises and deafness after rheumatic fever.*—Miss B., aged thirty-six, consulted me in 1851. She stated that ten years previously she had an attack of rheumatic fever, which was followed by dullness of hearing in the right ear, and accompanied by a constant whizzing sound and a pulsation, which extended over the head. The left ear has lately become dull. The watch was heard only when pressed upon the right ear, or at a distance of six inches from the left. Neither ear presented any appearance of disease, except a slight dullness of the surface of the left membrana tympani. The treatment consisted in applying mustard-plasters and stimulating liniments to the nape of the neck and the ethereal solution of cantharides behind the ears. The result of two months' perseverance was such an improvement of the hearing power that conversation could be more distinctly perceived, and the watch could be heard at half an inch from the right ear.

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* Hinton, Guy's Hosp. Reports, Third Series, vol. xiii. p. 160.

"*Total deafness following an attack of rheumatic fever.*—Mr. M. G., aged seventeen, a year and a quarter before consulting me had a bad attack of rheumatic fever, which was followed by noises in both ears and gradually increasing deafness, so that in a month after the fever he could not hear any sounds. Since the attack, has now and then heard loud sounds for a very short time; but when he saw me he was so deaf that he could not hear anything, even when the poker and tongs were knocked against each other. The ears had been syringed, blistered, and galvanized without any effect. There was no appearance of disease in either ear. The case was at once regarded by me as incurable.*

"*Partial deafness following an attack of typhus fever.*—Miss A. M., aged sixteen, saw me on March 1st, 1851. Eleven years previously she had an attack of typhus fever, and during the illness became so deaf as not to be able to hear the human voice. After the symptoms of fever had disappeared, the power of hearing slowly returned, until she was able to hear when loudly spoken to close to the head. There was no appearance of disease in either ear."

Deafness from the use of sulphate of quinia.—It is not uncommon for hardness of hearing, or even deafness, to supervene upon the administration of sulphate of quinia. This deafness is sometimes incurable, as the following case shows:

"In 1852, a colleague of mine, chief assistant at the Val de Grâce, presented to me his father, who, for five years, had been affected by complete deafness in both ears; my colleague hoping that I could effect a cure by electrifying the inner ear. The following are the particulars which were given to me in this case: M. X., captain of infantry, had, while in Africa, an intermittent fever, which was followed by a considerable hypertrophy of the spleen, which resisted treatment by quinine in the ordinary dose. The dose, consequently, had to be largely increased, and the treatment long continued. After that treatment, obstinate headache supervened, accompanied by intra-aural noises and hardness of hearing. At the end of some five or six months, the headache disappeared; but the intra-aural sounds continued, and the deafness gradually increased. The patient was subjected to various kinds of treatment, all of which failed, although they were directed by men well instructed in their professional specialty. On examining M. X., I ascertained, as more experienced men had previously, that the Eustachian tube was free on both sides, as also was the external auditory conduit. Nevertheless, the deafness was complete. M. X. could not hear even explosive noises; he only perceived the shock that they produced. I immediately resorted to my Faradisation of the ear. M. X., at each intermittence, perceived neither noise nor sensation in the depth of the ear, or in the tongue, although I had gradually raised the intensity of the current to a much higher than the ordinary degree. After ten trials, which produced no improvement, I abandoned that treatment, which, indeed, after the first electric exploration of the ear, offered me but little chance of success.

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* Toynbee, Diseases of the Ear. London, 1868, pp. 359–362.

"The fact of the incurableness of that case of deafness by the sulphate of quinia, adds importance to the therapeutic fact which I am about to relate:

"In bed No. 13, Saint Martha's ward, lay a young girl, who, for a long time, had suffered under a tertian intermittent fever; the spleen being greatly enlarged, and the disease of long standing. M. Briquet gave the patient a gramme of sulphate of quinia, every twenty-four hours, during nine successive days. From the first day she had a commencement of intra-aural noises, which increased from day to day, and became complicated by a deafness so decided that the ticking of a watch, placed in contact with the ear, could not be heard on either side, nor could even the loudest tones of voice be heard. The patient remained in that state for a fortnight, when M. Briquet, seeing no other means of cure, requested me to subject his patient to Faradisation of the ear. The operation was performed in my usual manner. On the excited side, the patient heard a sound, and felt numbness in the tongue, followed by prickings. Scarcely was the operation at an end when, on the excited side, she heard the tickings of the watch and the conversation of the persons around her. On the opposite side, the deafness still persisted. On the following day only that side was in its turn subjected to the electric excitation, which provoked the same sensations as the first operation had provoked in the other ear, but not so freely and completely. On the third day I made another electrical operation, which sufficed to restore the hearing to its normal state. From that moment, also, the intra-aural sounds ceased. The patient remained a fortnight after her cure, so that its permanence could be well ascertained."*

"*Mumps.*—The peculiar poison which causes the disease generally known by the name of mumps, is very often the source of complete deafness, which, however, usually occurs in one ear only. In these cases the nervous apparatus is evidently affected, as the deafness comes on suddenly, is usually complete, and, as a general rule, no appearance of disease can be detected in the meatus, membrana tympani, or tympanic cavity. When the nerve is not wholly paralyzed, and some, although it may be a very slight degree of, hearing remains, the only plan of treatment which can be recommended is the use of gentle counter-irritation over and around the ears, at the same time that the ear is exercised by means of the elastic speaking-tube.

"*Bile.*—The circulation of bile mixed with the blood is sometimes a cause of nervous deafness."†

"*Repressed eruption.*—A patient had for several months been troubled with an intra-aural noise, analogous to that of the wheels of a mill. At the commencement of his infirmity, he attributed to the influence exerted on his ears by his business, thóse sensations which troubled him both by day and by night, not ceasing even when he slept. And he at length became so jaded and worn out by these abnormal sounds that he gave up his employment,—that of a miller. But the change produced no relief, and he came to us for advice. On inspecting the outer and exploring the inner ear, we perceived the integrity of both, with the exception of some cicatrices which we noticed upon the pavilion of the left ear. Our patient told us that these cicatrices proceeded from some cutaneous affection with which he had been troubled during several years. Some astringent topical applications had freed him from that affection, and very soon afterwards the aural disturbances commenced. It was beyond all doubt that we had to do with a transmigrating lesion. The ease with which we succeeded in restoring the organ of hearing to its physiological condition, confirmed us in that belief. In fact, we applied a large blister to the nape of the neck, and the raw surface took the character of the primitive cutaneous affection in proportion as the auricular lesion dispersed. Here the acoustic lesion had supervened slowly, and without real pain, for we cannot give that name to the annoyance caused by the subjective sensations. Moreover, the hearing was perfect; it is even to be observed that it was sharper, the patient perceiving the least sounds, even rustling."*

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* Duchenne. † Toynbee.

Nervous deafness from mental excitement.—J. M., aged sixty, a native of England, by occupation a manufacturer. He stated that he was totally deaf in the right ear for twenty-five years, and in the left for twelve years, and that the cause of the deafness was a sudden loss of property; but, upon close inquiry, he also stated that he had a brother and sister as deaf as himself. On testing his power of hearing, by a variety of hearing-trumpets, I found it was not increased by them; neither could he hear the watch when applied over his mastoid process, or between his teeth. Everything had to be written. If the floor was struck, he felt the vibration. He hears a constant noise, as if a wheel were going round, all the time. General health good.

Examination.—External meatus normal; membrana tympani good color, no defect; Eustachian tube free; throat, pharynx, and uvula slightly thickened and inflamed; tonsils not enlarged.

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* Traité pratique Maladies de l'Oreille, par Dr. E. H. Triquet. Paris, 1857, p. 436.

Has tried all kinds of treatment without benefit. He was sent to me by Dr. J. J. Woodward, U.S.A.

Hysteria.—In hysterical deafness you have the usual symptoms of hysteria affecting the senses, but especially the hearing, with intra-aural sounds, as buzzing, ringing of bells, etc., while parts of the ear appear healthy.

In the front rank of the nervous paralysis which Duchenne has seen cured surely and rapidly by the process of Faradisation, he places the deafness which is connected with the hysteric condition. He relates the following case:

"*Hysteric deafness of several months' standing rapidly cured by Faradisation of the motor muscles of the small bones and of the chorda tympani.*—A young girl, habitually quite regular, and otherwise generally healthy, occupying the bed No. 12 in Saint Martin's ward of l'Hôpital de la Pitié, was cured there, at the beginning of April, 1855, of a typhus fever; after which she was not regular again, though the general health appeared very good. During her convalescence at the hospital she had a very warm dispute, just after which she was seized with sobbing and choking, which, however, did not proceed so far as a complete hysterical fit. On the following day, at the very same hour in which on the previous day she had had the dispute which had so much affected her nervous system, the patient fell into a sort of cataleptic state, in which she continued for a whole hour and a half. That species of attack recurred several times during the remainder of her stay in the hospital,—a term of about six weeks. On leaving, she returned to domestic service; but her menstruation did not recur, and by degrees she perceived a constantly diminishing sensibility on her right side, at first in the arm, and then in the leg. At the same time the motion of the limbs was less, as was the strength, so that at length she was obliged to quit her employment as a domestic servant, and return to the hospital. At the time of her doing so, she could not keep in her left hand any object that was placed there. Under the care of M. Briquet, it was ascertained, by touching, pinching, and electrifying, that her whole left side was affected by cutaneous and muscular anæsthesia (trunk, limb, and face being all affected), and a muscular weakening so great as to make it difficult for her to walk, and to embarrass her considerably in the use of her arms. If any object was placed in her hand when she was not looking at it, she immediately let it fall. The organs of the senses were equally affected in the left side; the sight was considerably weakened, and smell, taste, and *hearing were abolished.* The mucous membranes of the nose, the ear, and the conjunctiva were completely anæsthetized, as was the skin of the pavilion and of the external auditory conduit. The patient was still further affected by continual and very various intra-aural sounds (buzzing, ringing of bells, and whistlings more or less strong and shrill), which completely deprived her of sleep.

"M. Briquet was so good as to permit me to try in this case the therapeutic action of the various modes of electric excitation, which he had seen me successfully apply to a considerable number of patients in his ward who were laboring under similar functional disturbances. In three visits, daily, the electro-cutaneous excitation restored the sensibility of the trunk and the arm (the lower limb was reserved by M. Briquet that he might make comparative trial of the oil of seeds of Croton Tiglium). I must add that after the electro-cutaneous excitations, the menstruation, which had been suspended from the commencement of the typhus fever, was restored to its normal regularity. It sufficed for me to pass the metallic rheophores along the nasal and lingual mucous membrane, to restore, with the general sensibility, the senses of taste and of smell. *I also restored the sensibility of the pavilion and of the external auditory conduit; but without modifying the functional disturbance of the hearing.* Then the patient being so placed as to give her auditory canal a vertical direction, I filled it with plain water, and, having plunged a metallic thread into that liquid, and taking care that the metal should touch neither the walls of the auditory conduit nor the membrane of the tympanum, and having placed the other wet rheophore upon the mastoid process, I passed intermittent currents from my inductive apparatus, with an interval of half a second. The current, extremely weak at first, was gradually augmented in strength, until a disagreeable, though not actually painful, sensation was experienced in the depth of the auditory canal. At each intermission, the patient immediately heard a slight dry, crackling sound on the excited side; but *she experienced no sensation* in the tongue. Immediately after the operation, she could distinguish the ticking of my watch at a very considerable distance, which previously she could not even when the watch was placed in contact with her ear; and she could hear the voice as well on the left as on the right.

"On the following morning I learned that the cure had been but temporary (it lasted an hour), but I ascertained that the hearing was weakened, and that the intra-aural sounds were neither so strong nor so annoying. I renewed, in the same manner as in the previous day, the operation upon the ear; it produced the same physiological effects, and the hearing immediately became normal. From the time at which the patient entered the hospital, her nervous crises had become more frequent; recurring every week, and sometimes lasting for one or two hours each attack. The cutaneous sensibility and the muscular strength, which had been for some time preserved, were lost again, and for several weeks the patient had her left arm contracted. However, she experienced no disturbance as to her hearing, and a few months afterwards left the hospital perfectly cured of her deafness.

"This species of deafness is not always complete; it is generally complicated by intra-aural sounds more or less strong and annoying. Generally the disturbance of the hearing exists only on the left side, as do the other disorders of the sensibility and mobility; but it sometimes also occurs that the deafness is on both sides, though greater on the left.

"It must not be inferred from the foregoing case that hysteric deafness is always a slight affection. I have met with cases which for years have obstinately resisted every kind of treatment. However, although I am not prepared to give the precise statistics of all the cases of hysteric deafness which I have subjected to electro-therapeutic experiment, I may say, approximately, that hysterical deafness is curable by that treatment in eight cases out of ten. Numerous cases of that form of deafness may be happily modified by peripheric excitation. In fact, I have seen such disappear before the simple Faradisation of the skin of the pavilion or of the external auditory conduit, and even of regions more or less distant from the ear. In those cases the same result would be obtained by any other kind of excitation; as, for instance, exciting injections into the external auditory conduit or of the Eustachian tube, or blisters applied in the vicinity of the ear. The reason is, that in hysterical disorders, as in certain general nervous disorders of the same nature, excitation of a very limited space of the cutaneous surface causes the disorder to disappear as if by magic."*

"*Bodily debility.*—It is difficult to draw a correct comparison between the number of cases dependent upon excess of mental excitement and those arising from overtasking the body; but from the data before me, perhaps those of the class now to be considered are the most common. They occur in both sexes, but are more frequently met with in the female; and present great variety of form as well as cause. Sometimes they are temporary, and produced by a long walk, heated rooms, late hours, etc., when noises, with diminished hearing power, come on, but disappear after rest. Other cases, and even some of those which come on suddenly, may, however, remain more or less permanent. Thus, cases have been met with, in my experience, in which patients have become totally deaf after the administration of too violent a purgative, or after an attack of diarrhœa or cholera, and after the nervous exhaustion attendant upon childbirth; in some instances of the latter, the deafness has begun with the birth of the first child, and increased with each successive birth, until at last the nervous power was wholly lost. Perhaps the most common cause of nervous deafness from physical debility is the want of proper care in the management of young persons, and particularly girls, when they are growing fast. In hospital practice, young nurse-maids, who carry heavy children, and whose night's rest is often disturbed, and youths just entering laborious situations, are found to suffer. Any cause, in fact, which reduces the nervous energy of the body to a state too low for the due regulation of the functions of the various organs of the frame, may be followed by a manifest depression of the nervous power of the ears, which shows itself not merely in diminished power of hearing, but often by singing and other sensations in the ear, and sometimes by severe pain, like tic douloureux. In cases where debility of the nervous system of the ear is the result of a debilitated state of the body, the pulse, as a general rule, is weak, and there are symptoms of previous or present indigestion. Generally no unhealthy condition of the organ itself is apparent; though in recent cases the cerumen may be softer and more abundant than usual, and in old standing cases may even be absent."

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* Duchenne.

"*Deafness produced by want of sufficient sleep.*—In the early part of 1855, a young gentleman, aged fourteen, was brought to me by his father, on account of gradually increasing deafness. He appeared to be in tolerable health, and was at school in the neighborhood of London. No cause could be assigned for the affection, which had so far advanced as to cause him great discomfort from his inability to hear what his masters said to him. On examination, it became apparent that the deafness depended upon debility of the nervous system, for there was no history of any other disease, nor was there any appearance indicative of disease. The patient had, however, occasional noises in the ears following overexertion, and he certainly was deafer when he was tired. On inquiry, I could discover no special cause for the deafness, as he followed the same rules and regulations which were pursued by all the boys in the school. I prescribed internally quinine, and a stimulating liniment externally, giving directions that he should not be overworked. In a month's time the boy was seen again, but remained in much the same state, so I requested to be allowed to see the lady with whom he boarded, in order to ascertain further particulars as to his mode of living. On the most minute questioning, no sufficient cause could be detected, except that, being very desirous to prepare his lessons well, he sat up so late that when the time arrived for getting up, he was so sleepy as to be roused with difficulty. It was at once rendered probable that the debility of the nervous apparatus of the ear might be dependent upon the want of sleep; and I therefore requested his friends to see that his duties were so relaxed that he could take as much sleep as he required, and gave directions that he should go to bed at eight o'clock, and sleep until he awoke of his own accord. The result was that for several successive nights he slept for fourteen hours, and by degrees the number was reduced to ten, which was his usual allowance for three weeks, at the end of which time he returned to me, when, to the gratification of all, it was found that his hearing was nearly restored, and he was no longer styled the 'deaf boy' at school. This patient has been seen by me twice or thrice since, at considerable intervals, in consequence of the deafness returning; but each time it was evident that the nervous system had been too much exhausted, and the administration of quinine, with less work, and an increase in the amount of sleep, soon restored the hearing.

"*Total deafness produced by the nervous shock consequent upon successive accouchements.*—Mrs. B., aged forty, pale, and of a nervous temperament, consulted me in 1850, on account of complete deafness in both ears. She stated that she had married in India ten years previously, and at the time of her marriage she could hear perfectly well. On the occasion of her first confinement, previous to which her hearing was still perfect, she suffered a good deal from exhaustion, and this was followed by a great degree of deafness, so that she could scarcely hear what was said to her, even when the voice was much raised. Upon getting up, and growing stronger, the deafness was so much relieved that she merely required to be spoken to a little louder than usual."*

The following case, occurring in my own practice, confirms the foregoing:

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* Toynbee, pp. 367, 369.

Mrs. Anna H., aged twenty-six, general health good, pulse 72, no deafness in her family. Has been deaf for four years, slowly progressing after the birth of every child, and never has had any pain or discharge, but is constantly annoyed by rushing and roaring noises and sounds as of machinery. Is only able to understand her children by the motions of their lips and by means of signs.

The supposed cause was a severe cold, which was followed by slight deafness for two years, with pain in the top of the head, temples, and eyes. Three years ago, she had an attack of partial paralysis of the hand, side, and face, when about six months pregnant. This was stated to have been treated by bathing with salt and water, etc.

On examination, the meatus was found natural and the cerumen of ordinary amount, the membrana tympani transparent, less convex than natural; the handle of the malleus not seen.

By the otoscope, air was observed to pass through the Eustachian tubes.

In the left ear the membrana tympani was more opaque and the meatus narrow.

Her previous treatment had consisted in merely syringing the ears and the introduction of glycerine.

" *Nervous deafness produced by overexertion.*—E. Clarke, aged thirty-one, a tall, muscular carter, was admitted under my care at St. Mary's Hospital, on January 27th, 1859. He stated that fourteen years before, when out of health, deafness came on in the left ear, accompanied by noises, sometimes like a kettle singing, at others like the ringing of bells. On recovering his health, he found himself perfectly deaf in the left ear, which has remained so ever since. Eleven weeks ago, when a good deal exhausted by hard work, he took a bad cold, during which singing came on in the right ear, with loud noises, like the ringing of bells, and were accompanied with so serious an amount of deafness that he required to be spoken to in a loud voice, within a yard of his head. The patient's pulse was weak, and he had a worn aspect, as from exhaustion of the nervous system. On examination, no appearance of disease was visible in either ear, and the Eustachian tubes were pervious. Two grains of quinine were ordered to be taken twice daily, and a stimulating liniment to be rubbed over the surface of the ears, at the back of the neck, and down the spine. In the course of a week the noises decreased greatly, and in a fortnight they had wholly disappeared, while the hearing power gradually increased; so that when he left the hospital at the end of six weeks, to use his own words, 'he at times hears quite nicely.'"*

ACUTE INFLAMMATION OF THE FACIAL NERVE WITHIN THE FALLOPIAN CANAL.†

"There occurs suddenly a cutting, drawing pain, without previous ear affection, in the cheek and the ear of one side, increasing by pressure on the stylo-mastoid foramen, and accompanied with paralysis of the muscles of the corresponding half of the face. Considerable febrile disturbance attends this affection from the very first day, and soon afterwards deafness and sounds in the ear are ushered in. If the disease is not checked, pain in the head, delirium or coma, and chills, and febrile paroxysms, set in, and finally death. In more favorable cases, an abscess forms under the mastoid process, the opening of which and the exit of the pus exerts a beneficial influence, the pains in the ear and cheek, the paralysis of the face and the fever, the hardness of hearing and the sounds in the ear disappear, and the recovery of the patient takes place.

"If the disease terminates in death, we find, upon dissection, the facial nerve, throughout its course, from the stylo-mastoid foramen outward, spongy, soft, and swollen, the auditory nerve softened to liquefaction; pus in the labyrinth, and in the root of the seventh and eighth nerves of hearing; a large quantity of serum between the membranes of the brain, the cerebrum softened; the membrana tympani and the meatus, on the contrary, in their natural condition. This last circumstance is the most valuable point in the diagnosis between the affection under consideration and acute and chronic inflammation of the labyrinth, attended, as the latter usually also are, with paralysis of the muscles of the side of the face corresponding to the affected ear; whilst this paralysis, in its turn, affords us the best means of distinguishing inflammation of the facial nerve from nervous otalgia.

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* Toynbee, p. 371.

† Translated from Kramer's Aural Surgery of the Present Day.

"An 'exaltation of the hearing' has been described as an especial characteristic symptom of inflammation of the facial nerve, and the consequent paralysis of the muscles of the face, and this phenomenon has been ascribed to a paralysis of the tensor tympani muscle, which is supplied by the facial with a nervous branch (Landouzy, Longet). If we consider, however, that in the case adduced as proof of this, the inflammatory process was only of short duration and moderate development, the ensuing paralysis of the facial nerve, on the contrary, of very long continuance, and in no wise corresponding to the only sometimes accompanying 'exaltation of hearing,' and if also we consider that the same 'exaltation of hearing' takes place in very many other diseases of the ear, we must believe this theory to be entirely unfounded.

"Acute inflammation of the facial nerve is a very rare affection, and is only caused by the violent effect of cold; for instance, washing the face, whilst covered with perspiration, in cold water, cold currents of air directed against the head, when greatly heated, etc.

"The prognosis is doubtful, and through neglect of the patient or physician, the inflammation may extend to the brain and its membranes, and life be endangered.

"The treatment must be strongly antiphlogistic; the necessity of blood-letting must be determined by the general symptoms, and whether the brain is involved. Otherwise, it is sufficient to apply a large number of leeches, which may even be repeated, to the neighborhood of the stylo-mastoid foramen, to rub gray mercurial ointment into the surrounding parts, and, on the occurrence of painful swelling behind the angle of the lower jaw, to apply hot emollient poultices of linseed-meal, and to open with the bistoury, as soon as possible, the abscess, on the slightest appearance of fluctuation.

"If the inflammation communicates itself to the brain and membranes, with the well-known symptoms, leeches and werful purgatives, and ice-cold applications to the occiput, e necessary, to prevent, if yet possible, exudations into the vity of the skull.

"If the inflammation is subdued, without, however, the ralysis of the muscles of the face being prevented, the unction of pustulating ointment or iodine ointment is oper, in order to promote the absorption of the exudations the Fallopian canal, and thus to remove the paralysis the muscles of the face."

ACUTE INFLAMMATION OF THE LABYRINTH.

"The pains are in most cases deeply seated in the ear, and tended with violent fever, loss of consciousness, and conulsions, in other cases only moderately severe, and extendg over the temporal region, and the corresponding half of e head, and attended with but slight fever, incapability of olding the head erect, drowsiness, vomiting; a sero-purulent scharge takes place from the ear within the first twenty-four ours from the commencement of the attack, but no alleviaon is produced, and death may take place in a few days, or a few weeks, with the well-known symptoms of inflammaon of the brain.

"In either case there is found, on dissection, injury to or estruction of the membrana tympani, the small bones of the ar, and the bony labyrinth, sero-purulent effusions into the iddle and inner ear, hardening of the cortical substance of e cerebrum and cerebellum of the affected side, and similar sults, which show, beyond all doubt, the acute inflammary character of the affection.

"It may be caused by mechanical injury of the membrana mpani extending to the labyrinth, by sharp-pointed instruents; for instance, by the incautious insertion of a pin for e purpose of cleaning out the ear, or by awkward and forcile attempts to extract, in spite of the struggles of the patient, reign bodies by means of hooks, forceps, levers, and similar struments.

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le. In all cases, the pains in the head are rendered unbearable by walking or riding on stone pavements, by taps on the head with the finger, etc., the spirits become depressed, followed by drowsiness, with inability to hold the head erect, and paralysis of the muscles of the face, and even of the upper arm of the corresponding side. Sooner or later are added vague febrile disorders, returning with or without heats and morning sweats, from which is developed typhus fever, with coma, delirium, convulsions, vomiting, etc., and the patient is delivered by death from his sufferings. Long before this stage, the discharge from the affected ear assumes an ichorous and offensive character, and the hardness of hearing is changed to complete deafness.

"If the patient is in a condition in which ocular inspection of the affected ear at a window by strong sunlight is possible, the above-mentioned fleshy growths are discovered, in a few cases, in the meatus, but far oftener the membrana tympani is either partly or entirely destroyed, the small bones of the ear consumed, the tympanum filled with dirty pus, and its lining membrane of a dark-red color, and covered with fungous granulations, or partially destroyed; with the probe, the carious surface of the bone may be distinctly felt. If death ensues, there is, in addition to the caries of the labyrinth, a similar condition of the Fallopian canal, whilst that portion of the dura mater which covers the petrous portion of the temporal bone is found injected, loosened, thickened, and covered with pus, the cerebrum and cerebellum (most frequently the latter) changed in various ways by the inflammatory process, congested, softened, and containing abscesses, which communicate by carious openings in the petrous portion of the temporal bone with the labyrinth and tympanum. These lesions are of so important a character, and the primary ear affection (chronic inflammation of the perforated membrana tympani) thrown so much in the background by long continuance and neglect, that during the existence of this life-endangering complication with secondary brain symptoms, it has been so little thought of that, in explaining the appearances presented

"The diagnosis is confirmed by the knowledge of the cause of the pain, and by the discovery by sunlight of laceration or injury of the membrana tympani, and of the filling of the tympanum with blood or bloody serum.

"The prognosis is very unfavorable in cases attended with serious brain symptoms, such as profound coma, etc., and even in those in which the inflammatory symptoms are strongly marked, there is great danger to life.

"The treatment must in all cases be energetically antiphlogistic; besides a cool and elevated position of the head, and the maintenance of quiet in the neighborhood of the patient, cooling drinks, antiphlogistic and purgative medicines, copious and frequently repeated bleedings are necessary around the affected ear, and at the nape of the neck, ice-cold applications to the occiput. If the pain obstinately persists, the ear must be surrounded with warm poultices of bruised meal, day and night, whilst the ice-cold applications are continued to the occiput.

"If by these means the inflammation in the ear and membranes of the brain, the violent pains, etc,, are subdued, the life of the patient is saved, but the hearing of the affected side is generally lost.

CHRONIC INFLAMMATION OF THE LABYRINTH.

"After an apparently harmless flow from one or both ears, varying greatly in quantity and quality, and attended with a greater or less degree of deafness, has lasted for several years, the patient suddenly complains of dull pains in one ear, extending with greater or less rapidity to the temporal region, the top of the head, and the nape of the neck. Sometimes, but less frequently, however, the pains in the ear are very acute, and extend to the adjoining cheek, the tongue, the soft parts of the neck, and the upper arm, in such a radiating manner that they have been frequently confounded with 'tic douloureux.' In these cases, the meatus is filled near its entrance, or even in its deeper portion, with extremely sensitive fleshy vegetations, by which the examination with ear specula or probes is rendered very difficult, or even impossible. In all cases, the pains in the head are rendered unbearable by walking or riding on stone pavements, by taps on the head with the finger, etc., the spirits become depressed, followed by drowsiness, with inability to hold the head erect, and paralysis of the muscles of the face, and even of the upper arm of the corresponding side. Sooner or later are added vague febrile disorders, returning with or without heats and morning sweats, from which is developed typhus fever, with coma, delirium, convulsions, vomiting, etc., and the patient is delivered by death from his sufferings. Long before this stage, the discharge from the affected ear assumes an ichorous and offensive character, and the hardness of hearing is changed to complete deafness.

"If the patient is in a condition in which ocular inspection of the affected ear at a window by strong sunlight is possible, the above-mentioned fleshy growths are discovered, in a few cases, in the meatus, but far oftener the membrana tympani is either partly or entirely destroyed, the small bones of the ear consumed, the tympanum filled with dirty pus, and its lining membrane of a dark-red color, and covered with fungous granulations, or partially destroyed; with the probe, the carious surface of the bone may be distinctly felt. If death ensues, there is, in addition to the caries of the labyrinth, a similar condition of the Fallopian canal, whilst that portion of the dura mater which covers the petrous portion of the temporal bone is found injected, loosened, thickened, and covered with pus, the cerebrum and cerebellum (most frequently the latter) changed in various ways by the inflammatory process, congested, softened, and containing abscesses, which communicate by carious openings in the petrous portion of the temporal [illegible] with the labyrinth and tympanum. These lesions are [illegible] important a character, and the primary ear affection [illegible] inflammation of the perforated membrana tympani) [illegible] so much in the background by long continuance and [illegible], that during the existence of this life-endangering [illegible]cation with secondary brain symptoms, it has been so [illegible] thought of that, in explaining the appearances presented on dissection, a primary character has been assigned to them, instead of to the ear affection (Itard, Otorrhœa cerebralis primaria).

"In a very few cases, the periostitis of the petrous portion of the temporal bone does not extend to the dura mater and brain, but terminates in the exit of the pieces of carious bone. The most remarkable instance of the kind known was that of a boy seven years of age, from whose left ear, which had been discharging pus for several years, a carious piece of bone, 1″ long and ½″ thick, was removed, on which the meatus auditorius, 3-5‴ deep, the diploë of the petrous portion of the temporal bone, and the two windows were distinctly recognized. After the removal of a second piece of bone, the sore in the external meatus healed within four weeks without any unfavorable symptoms, so that the boy, although, to be sure, completely deaf in that ear, and with paralysis of one side of the face, was in a condition to be discharged from the hospital.

"The chief point in the diagnosis between chronic and acute inflammation of the labyrinth is the slow development of the first from a long-existing inflammation of the membrana tympani, which is probably always perforated, and of the adjoining lining membrane of the tympanum.

"It is seldom that we can discover the causes of the extension of chronic inflammation of the membrana tympani to the mucous membrane of the tympanum, labyrinth, etc., except in the case of taking cold; the abatement of the discharge from the ear, which sometimes takes place at the same time with the occurrence of the life-endangering symptoms, cannot be considered as the cause of the latter, but as the simultaneous effect of some increased irritation of the lining membrane of the tympanum.

"The prognosis is in a high degree unfavorable, especially in cases where polypus and fungous growths are found in the meatus or on the mucous membrane of the tympanum, above all, however, in cases in which typical chills have taken place several times in twenty-four hours, for this is the indication of a fatal formation of pus in the cavity of the skull. Superficial caries in the tympanum is not dangerous to life; even paralysis of the muscles of the side of the face corresponding to the affected ear is not always incurable. If the danger to life is averted, the hearing is nevertheless destroyed in the affected ear.

"The treatment must be prompt and energetic locally, antiphlogistic; an elevated position of the head, in a cool room, on a horse-hair pillow; copious evacuations by means of calomel, etc.; leeches in as great numbers as the strength of the patient will bear, applied in the neighborhood of the affected ear, and to the occiput; ice-cold applications to the latter; finally, a powerful pustulating ointment between the occiput and the nape of the neck, applied until a plentiful eruption is produced, which should be kept discharging according to circumstances."*

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* Kramer, pp. 15–120.

CHAPTER XVIII.

TREATMENT OF NERVOUS DEAFNESS.

We know of no special remedies for nervous deafness. Its treatment can only be founded upon a correct diagnosis, and a knowledge of general principles. Yet we would invite the attention of our readers to the modes of treatment we have employed, with such modifications as are indicated by variations due to the age, constitution, habit, occupation, etc. of the patient.

"Inasmuch as marked improvement sometimes occurs in this variety of deafness, we should never neglect in the beginning to exhibit the so-called resorbents (among which remedies good nourishment certainly ranks high). Injections of iodide of potassium (grs. ij to xx, distilled water f℥i) through the catheter may be of value in recent cases. In old cases, such as usually come to the aural surgeon, I have never seen any decided benefit either from local or general treatment. Only once have I seen any great benefit to the hearing from local treatment (the use of Politzer's method and the catheter). In this case, however, before any treatment was begun, some of the hearing power had returned after absolute deafness had existed for six months."*

The treatment of the first class of cases, those which are hereditary, or the result of mental emotion, consists in the use of alteratives and tonics. If these fail, and there is exalted sensibility, then we resort to the use of sedatives and anodynes applied to the Eustachian tube or to the external meatus, such as acetate of morphia, gr. 1-12 to 1-8, dissolved in ʒi of water, with a few drops of acetic acid, to which is added a small portion of eau de cologne. This may be applied on a small pledget of cotton, or by means of a nebulizer, or one of the apparatus before described. Sulphuric ether or chloroform may be used in the same manner.

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* Von Tröltsch.

The second form of nervous deafness results from cold and its consequences. The treatment is commenced by leeching or dry cupping below the ear, by the application of tincture of iodine, with the internal use of small doses of mild purgatives, followed by tonics, as sulphate of quinia, iodide of iron, with cod-liver oil. Change of air to the seashore in extreme hot weather, and later in the season to the mountains, may be of service. For those whose means will not permit them to travel, resort may be had to the salt-bath, friction to the skin, and gymnastic exercises, and care, during the prevalence of easterly winds or extreme cold, to cover the ears. In chronic cases, warm air should be blown by Politzer's air-bag through the nose, with or without the vapor of iodine. Or by means of the nebulizer a solution of sulphate of zinc, grs. iij–v, to water f℥i, alternating with a solution of muriate of ammonia, grs. xx to water f℥i, may be employed daily for three or four weeks, or till benefit is derived.

In the third variety of nervous deafness, arising from compression or white softening of the auditory nerve in the internal ear, there is severe and constant headache, vertigo, noises of various kinds within the ear, double hearing, impaired sight, with or without weakness of the mental faculties.

In the treatment of this class of cases, the general condition of the patient must be always borne in mind. If the patient is plethoric, venesection is indicated by cups to the nape of the neck, or leeches at the base of the mastoid process, to be followed by the internal administration of acetate of potassa and sulphate of magnesia, in small and repeated doses, to diminish the excess of serum in the blood. Should these means fail, we may employ alterative doses of some form of mercurial alone, or in combination with iodine or iodide or bromide of potassium. A favorite remedy is the protiodide of mercury, gr. i, in combination with extract of belladonna, gr. 1-12, or opium, gr. ¼. If the case should become chronic, we may employ with advantage strychnine from 1-30 to 1-20 of a grain twice a day. We apply the galvanic or electro-magnetic current, a full account of which will be given under the proper head.

The fourth variety comprises a very large class of cases, the result of the poisoning of the blood by typhus, typhoid, scarlatina, cerebro-spinal meningitis, or inflammation of the labyrinth.

In the treatment of these cases our chief dependence is on changing or modifying the blood by tonics and alteratives, with counter-irritation and nervous stimulation. One of the most efficient agents known is strychnia or its preparations. Commencing the treatment with the administration of the sixtieth of a grain of the sulphate of strychnia, increasing the dose until the patient experiences its physiological effects; occasionally intermitting it for one or two weeks, and thus continuing its use for months. In case this treatment should fail to benefit the patient, small doses of Fowler's solution of the arsenite of potassa, gtt. iij thrice daily, in water, will prove useful. This should be given for one week, and then omitted for an equal period, and thus continued for some time, with regular intermissions.

In other cases, in which there is a scrofulous diathesis associated with these affections, chloride of barium will be found a valuable remedy. The solution, in pure water, should be administered in doses of five drops, twice daily, until nausea, purging, or vertigo are produced, always remembering that the remedy is a powerful one, and should be discontinued on the appearance of unpleasant symptoms. We may try the acutal cautery, at a white heat, behind the ear and on the nape of the neck, repeating this at intervals.

If all these means are ineffectual, we resort to the galvanic current of Grove's, Daniell's, or Bunsen's battery (or Siemens-Halske's modified elements, after Brenner's arrangement), one pole applied within the meatus by means of an insulated electrode, in a weak solution of common salt, the other pole being placed in the hand of the patient or over the mastoid process.

The fifth class of cases are seen in connection with hysteria, or as a result of large doses of quinine. In the first variety we depend upon purgatives, antispasmodics, and emmenagogues. Failing in these, we resort to the electro-magnetic current.

In regard to the treatment of those cases which are dependent upon large doses of quinine, it is important that all the eliminating organs should be in active operation, with the persevering use of galvanism or electro-magnetism.

The sixth class of cases are the result of the poison of syphilis. These cases must be treated with specific remedies, but with great care, combining them with tonics, especially the tartrate of iron and potassa.

In young persons who are deaf, the supposed cause being inherited syphilis, and who have the peculiar condition of the teeth described by Mr. Hutchinson* as pathognomonic of this disorder, viz., the central upper incisors being usually short and narrow, widely separated from each other, with a broad vertical notch in their edges, and having their corners rounded off, the treatment should consist principally in attention to the patient's general health. With regard to drugs, we believe that mercury judiciously used is to be our chief dependence. In children and young persons, the best mode of employing it is by inunction, the mercurial ointment being rubbed into the thighs and armpits twice a week, for twenty minutes at a time. For those who are more advanced in life, the following mixture may be prescribed:

℞.—Bichloride of Mercury, gr. i;
Iodide of Potassium, ʒi-ʒij;
Water, f℥iv;
Oil of Bitter Almonds, gtt. ij;
Syrup, f℥iv;
Brandy, fʒij.

Mix the Bichloride with the Oil of Almonds and Brandy, and then add the other ingredients.

Sig. A tablespoonful to be taken twice a day, after meals.

We should be careful to have the patient well covered by warm clothing, if the weather be cold, and he should also have a full and varied diet, avoiding green vegetables or acid fruits.

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* A Clinical Memoir on Certain Diseases of the Eye and Ear Consequent on Inherited Syphilis. London, 1863, p. 204.

The foregoing prescription may also be used for young persons, diminishing the dose in proportion to the age. After its use for a month or six weeks, the iodide of iron is to be substituted for the bichloride of mercury.

Hinton* states that "among the poorer classes of the community (London), the number of persons whose hearing has been destroyed by hereditary syphilis is unhappily very large. At Guy's Hospital it has furnished more than one-twentieth of the aural patients. Evidently it is the disease, or one of the diseases, which Sir William Wilde† described as affecting the ears in early life, subsequently to or alternating with an inflammatory affection of the eye. The patients present the now familiar aspect of hereditary syphilis, and have, in every case I have met with, suffered from impaired vision before the deafness has arisen. This deafness makes its appearance generally between the tenth and sixteenth years; about but not precisely coinciding with the period of puberty. The great majority of cases that I have seen have been in females. In one case the deafness was at first greatly aggravated at the catamenial periods, but it became afterwards almost complete."

"Besides their other symptoms, but too well marked, especially among the poor, patients suffering from this disease may, as a rule, at least when they are young, be at once distinguished by the amount of deafness which they exhibit. I know of no other affection, except fever, which in a person under twenty brings on a deafness so rapid and so nearly complete. In the course of a few weeks a girl, previously hearing well, will, without pain or known cause, become unable to distinguish words. Perhaps her eyes, which have been long inflamed, have about the same time been cured. On examination, it is found that a tuning-fork placed on the head is heard for a very short time, or not at all. The meatus is free from wax, the membrana tympani looks somewhat white and rough; it may be flat or too concave, but generally has a dried-up look, as if its juices were deficient. The throat is by no means always unhealthy; the Eustachian tube may or not be pervious. In the latter case, the opening of the tube, by the catheter or other means, affords some relief, which, however, is apt not to be permanent."

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* Diseases of the Ear, by Joseph Toynbee, with a Supplement, by James Hinton, Aural Surgeon to Guy's Hospital. London, 1868, p. 461.

† Aural Surgery, p. 273, Otitis in Connection with Ophthalmia.

NERVOUS DEAFNESS CAUSED BY WANT OF FOOD.

In a case of nervous deafness, the only cause for which was the habit of going for many hours without food, Toynbee* found good results from the use of creasote and morphia. His treatment consisted in making gentle counter-irritation over each ear, the back of the neck, and down the spine, and in administering creasote and morphia, in doses of two or three minims of the former to one-twelfth of a grain of the latter, twice a day. This treatment was continued for four months, while at the same time every means for restoring the general health were resorted to, and at the end of the treatment the hearing power was so greatly improved that the patient could both hear and take part in general conversation.

THE TREATMENT OF NERVOUS DEAFNESS BY ELECTRICITY.

The first form of electricity employed in medicine was frictional, obtained chiefly from glass, which, owing to its being so easily dissipated, its too rapid and incontinuous action, confined with great difficulty to conductors, renders its employment rare as a therapeutic agent.

The second form was galvanism or electricity developed by chemical action. Thus, by means of a galvanic current passed through the eye, we produce the effect of light, through the auditory nerve that of sound, and the nerves of smell and taste may be similarily acted on. Dr. Wilson Philip has asserted that he could excite the secretion of the gastric juice by sending a current along the divided pneumogastrics.

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* Diseases of the Ear, by Joseph Toynbee, p. 372.

The first apparatus for generating chemical electricity was the pile of Professor Volta, of Pavia, a description of which is published in the Philosophical Transactions, London, 1800; although the discovery of galvanism is due to Galvani, Professor of Anatomy at Bologna, who found that by forming a chain of conducting substances between the outside of the muscles of the leg and the crural nerve of a frog, convulsions might be produced. Galvani previously entertained the false idea that the contractions of the muscles of animals were dependent on electricity.

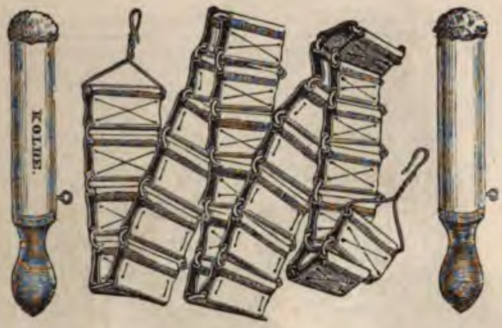
The invention of the pile by Volta was the result of profound thought on the development of electricity at the surface of contact of different metals. The galvanic pile of Volta consisted of an equal number of silver coins and pieces of zinc of the same form, with circular disks of card, soaked in salt-water; of these he formed a pile or column by placing them alternately. If the uppermost disk of metal, either copper or silver, be touched with the finger, previously moistened, while a finger of either hand is applied to the lowest disk, a distinct shock is felt, which is increased with the number of plates.

Instead of the moist conductor, we now use liquids of various kinds, and electricians have devised numerous forms of batteries, but all are based on the important principle discovered by Volta. Still, to Galvani is due the discovery of animal electricity, for he demonstrated that the contact of the nerves of the frog would produce a current of electricity.

In 1827, Nobili confirmed the results of Galvani by means of a delicate galvanometer; but Von Humboldt, Matteucci, and Du Bois-Reymond developed the important facts which are the foundation of electro-physiology, and which led to the application of the galvanic current to the treatment of disease.

The important discovery of induced currents by Faraday, gave Duchenne the means of prosecuting his valuable investigations, and also fired Remak to repeat Duchenne's experiments, and to improve his method by exciting the motor nerves, and not the points of entrance of the nerves into the muscles.

Fig 101.

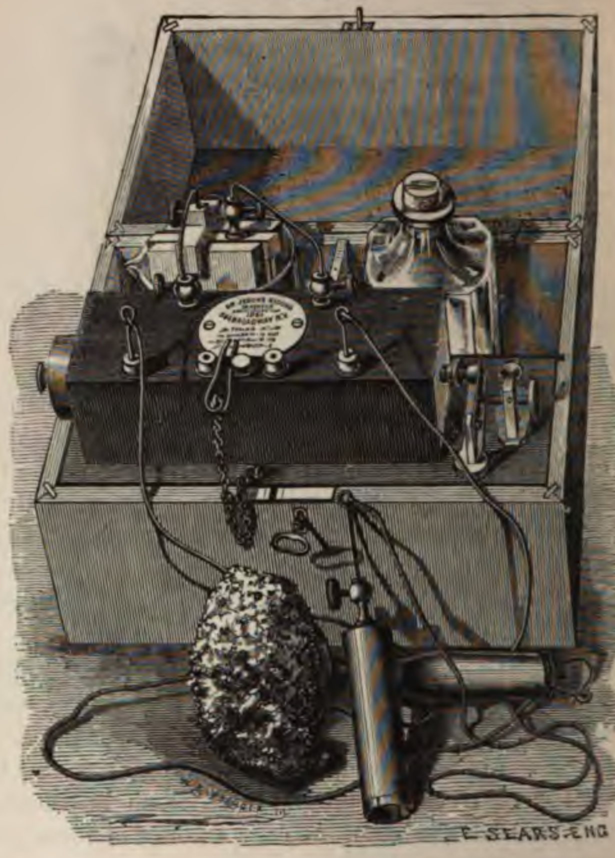


This simple apparatus is still employed, only substituting copper for silver and cloth for card, as in Pulvermacher's chain, or in Fig. 101, modified by Dr. Hackley, or in the forms altered by Prof. Hammond and Dr. Palmer. All these batteries are inconstant and not steady in action. They are chiefly applicable to the skin. Prof. Daniell was the first to invent a galvanic battery capable of constant and steady action. He amalgamated the plate of zinc with mercury, preventing local electric action; and used porous partitions, thus freely transmitting the electric current, but preventing the passage of the sulphate of zinc to the copper plate.

Another form of battery was proposed and put in operation by Prof. Grove, of London, which is an improvement even upon Daniell's, in respect to the amount of force generated in a small space. Prof. Smee has also invented a battery, bearing his name, which is very nearly constant. It yields electricity in great quantity, and is always ready for use. This form has been adopted by one of our most intelligent physicians and mechanicians, Dr. Jerome Kidder, of New York City, in his electro-magnetic apparatus, also in the form of a compound Smee's battery, which is convenient and portable, and yields all the electricity that is required for operations upon organs as sensitive as the eye and ear.

He has also applied the principles discovered by the lamented Faraday by furnishing his beautiful machine with

Fig. 102.



coils adapted to vary the quantity and tension to any desired degree,—advantages for medical purposes.

By means of two systems of helices or coils of wire, equal alternating currents are produced on their circuits, being closed and opened by a double-armed vibrating arrangement. There are six currents, any two of which can be combined as a negative and positive. The currents from the poles A and D (the bundles of wires in the new machine being covered with a copper cylinder) can be used with a small wet sponge or with the apparatus of Duchenne (see Fig. 105), placed in the ear with warm water and salt. We have also employed the magneto-electric machine (see Fig. 103, also Fig. 104 of Sexton, modified by Neff), which is especially powerful and effective, and may be substituted for the apparatus which I have described. This form of apparatus presents the advantages of being always ready for use and requiring no initial voltaic current to set it in motion. In it there is but little chemical influence on the organs of taste

Fig. 103.

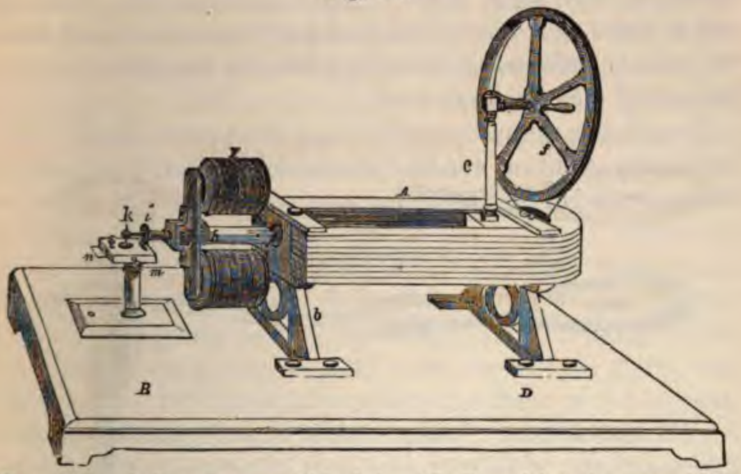
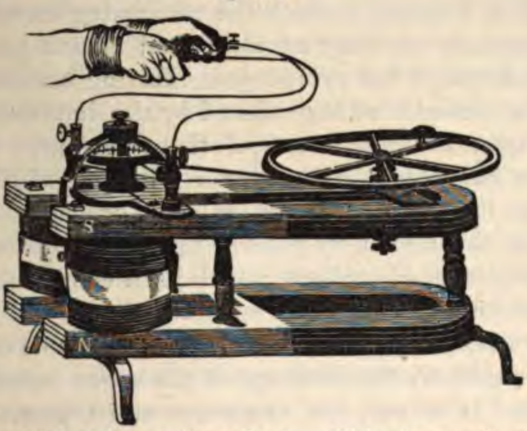


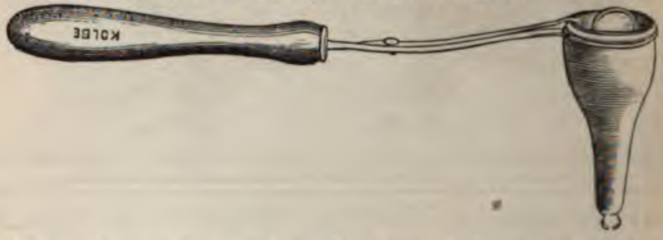
Fig. 104.



and smell, while there is a perceptible influence on the sense of touch, and muscles of the body are caused to contract. The magneto-electric machine at Fig. 103 will not readily decompose the fluids of the body, being useless in removing tumors of any kind, yet in Page's machine (Fig. 104), in which there is a double magnet and intense coils of wire, the current becomes sufficiently powerful for electrolysis or imparting magnetism to iron.

In applying the interrupted or constant current to the ear, we employ a button conductor outside the ear, a sponge, or the apparatus of M. Duchenne.

Fig 105.—RHEOPHORE OF DUCHENNE.



"That the patient might be spared from pain, M. Duchenne got M. Charrière to construct an auricular rheophore (Fig. 105, A), in which the conducting metallic thread is insulated by an ivory envelope, and cannot penetrate to the membrane of the tympanum. Having waited until the noise had ceased that is produced by the impression of the liquid upon the membrane of the tympanum, place the auricular rheophore in connection with one of the conductors of an inductive apparatus (galvanic or magneto-electric), and close the circuit by placing upon the mastoid process the other wetted rheophore, which itself communicates with the second conductor of that apparatus.

"The inductive apparatus which serves for this experiment is appropriate to the delicacy of the organ upon which it acts; that is to say, the minimum of its power must be scarcely appreciable when the metallic rheophores are applied upon the extremity of the tongue, and it must be in our power to graduate it with precision and upon a scale of great extent.

"The rheophore being placed in the auditory conduit, which was previously half filled with water, and the apparatus being at its minimum, as intimated above, we perceived at the very moment of the intermittence a small, dry sound, like the crackling of parchment, which could clearly be traced to the bottom of the external auditory conduit. The intermittences having occurred with extreme rapidity, the sounds approached to the likeness of those made by the beating of a fly's wings between a pane of glass and a curtain. The intensity of the little sounds which have just been described increased in direct proportion to the increase of the current. Sensation was perfectly limited to the point at which the sound appeared to originate. After a certain time of excitation, and at a certain degree of tension of the current, a kind of tickling in the right side of the tongue, at the junction of its posterior third with its middle third, was plainly felt. Still gradually raising the force of the current, felt the tickling sensation as gradually progressing toward the point of the tongue, then experienced a numbness and a disagreeable pricking, which did not go so far as actual pain."*

Brenner† has published the following observations in regard to the effect of electricity on the organ of hearing. "If the cathode is placed in the auditory passage, filled with water, and the anode is connected with any other part of the body, there arises, when the circuit is closed, a strong sensation of sound, which continues during the flow of the current, but gradually dies away when the circuit is opened.

"If the anode be placed in the ear, no sound is heard either at the moment of making the connection or during the continuance of the current, yet when the circuit is broken a slight sound is perceived. These reactions Schwartze and Lucae have not been fully able to establish; on the contrary, the latter has observed that when the cathode (zinc or negative pole) is placed in the ear, and the anode (positive or copper pole) on the neck or hand, a painful drawing sensation is perceived in the ear at the closing and during the flow of the current, which immediately ceases with the opening of the circuit. When the anode (copper pole) is in the ear, a less painful drawing is produced, which also vanishes when the current is interrupted. When the induction current is used, there is, moreover, observed a sensation as of a roaring and rushing wind, which is produced by the presence of water in the auditory passage. There is also a tickling, pricking feeling, which by means of a very intense current may be made unendurable. At the same time there is perceived an unpleasant taste on the corresponding side of the tongue, probably in consequence of the irritation of the chorda tympani, which descends from the cavity of the drum of the ear against the gustatory nerve, and in common with it reaches the submaxillary salivary gland."

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* M. Duchenne (de Boulogne), "De l'Électrisation localisée et de son Application à la Physiologie à la Pathologie et à la Thérapeutique." Paris, 1855.

† Zur Electrophysiologie und Electropathologie des N. Acusticus, Petersburger Med. Zeitung, 1866.

Altheus has remarked that there is an increase in the flow of saliva.

"Remak* found that the galvanic current possesses far more therapeutic properties than the induced currents, and that very often where the former may be beneficial, and effect a cure, the latter will be useless or even injurious. One of the chief advantages of the galvanic current is that, in a painless way, and without shock, we can introduce into the system a large amount of electricity, which is often indispensable, considering the enormous resistance of the body to the electric current. Remak published numerous articles on the galvanic current, but his principal work is 'Galvanotherapie der Nerven und Muskelkrankheiten.' Berlin, 1858."

I have employed the interrupted current in my own person and in numerous patients. There was never much pain, and the suffering was not more than a feeling of warmth in the ear, with more or less noise, like that of an insect buzzing. If the uncovered button is applied to the skin of the tragus, it is always more or less painful, and if kept long will produce a blister.

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* Galvano-Therapeutics: the Physiological and Therapeutical Action of the Galvanic Current upon the Acoustic, Optic, Sympathetic, and Pneumogastric Nerves, by William Neftel, M.D. New York: Appleton & Co., 1871.

Dr. Neftel states that he has made numerous experiments on the healthy and diseased auditory apparatus, and can fully confirm all the statements of Brenner,* as has also been done by Erb† and by Hagen.‡

"According to Brenner, the pain is quite characteristic for each electrode. When the positive electrode is in the ear, the pain is accompanied by a sensation of pressure, entering from without toward the tympanum. When, on the contrary, the negative electrode is applied, a sensation of something apparently pressing from within outward is felt, so that the individual on whom the experiment is made can distinguish with great precision the direction of the current.

"Vertigo very often attends the application of the electrodes to the fossa auriculo-maxillaris, and to the head; but this never occurs, no matter how strong the current may be, when the electrodes are so applied that a supposed line connecting them is parallel to the plane passing through the antero-posterior diameter of the head. As soon, however, as the line connecting the electrodes forms an angle with this plane, vertigo will invariably take place, and will be most intense when a right angle is formed.

"In both methods the current traverses a more or less oblique plane of the nerve,—*i.e.* is not axial, because the *sympathetic* is also galvanized when the current deviates from the antero-posterior plane. On account of the sensitiveness of the membrana tympani, Brenner considers it better not to introduce the ear-electrode into the meatus, but to apply a button-shaped electrode to the tragus, pressing it inward, I suppose on a sponge, so as to occlude the meatus. The indifferent one must not be applied to the temple or mastoid process, as was formerly done, but rather to a distant part, as the neck or hand.

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* R. Brenner, Untersuchungen und Beobachtungen, auf dem Gebiete der Electrotherapie, Bd. i. Abt. i. Leipzig, 1868 und 1869.

† Knapp and Moos's Archives of Ophthalmology and Otology.

‡ Hagen, Electro-Otiatresche. Leipzig, 1866.

"Pflüger* has discovered that in the electrotonic state the irritability of the nerve undergoes a striking change; it is wonderfully exalted in the region of the cathode (catelectrotonus), and lowered in the region of the anode (anelectrotonus). The reason why sensation is exalted is that alkalies, which are deposited at the negative pole, excite pain, while acids, which are deposited at the positive pole, soothe irritation. Hence the positive pole (anelectrotonus) soothes, the negative (catelectrotonus) excites." The fact is given by the Germans. Its explanation is due to MM. Legros and Onimus.†

"If we apply the cathode of a weak current to the ear, and the anode to the neck or the hand, closing the circuit in the metallic part in which a commutator is intercalated, a pricking, burning sensation is felt at first, followed by the other symptoms accompanying galvanization of the ear. On increasing the intensity of the current, a sound is perceived, usually a distinct metallic ringing (alkali at the cathode excites again). This acoustic perception is most distinct at the closing of the circuit, lasting but a few seconds of the current duration, and not reappearing at the breaking of the circuit. On reversing the current direction by means of the commutator, so that the ear-electrode becomes the anode (acid at anode soothes; no sensation), and the indifferent one, the cathode, no acoustic sensation is perceived, either at the closing of the current or during its continuance. The sensation appears again, however, at the breaking‡ of the circuit, when it is like that perceived at the cathodic closing, though feebler and of less duration. This reaction of the acoustic may be expressed by the following formula (Brenner):

KaCS: The closing (*C*) of a galvanic current produces an acoustic sensation (sound, *S*) when the auditory organ is under the influence of the cathode (*Ka*).

KaDS>: This acoustic sensation continues with dimin-

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[*] Pflüger, Untersuchungen über die Physiologie des Electrotonus, Berlin, 1859; Neftel's Galvano-Therapeutics, p. 32.

[†] Observations on the Effects of Electric Currents, translated by J. Solis Cohen. Philadelphia, 1870.

[‡] Disturbing the soothing effects of the acid at positive pole (anode).

ishing (>) intensity, and soon completely disappears during the continuance (duration, *D*) of the current.*

KaO—: At the opening (*O*) of the circuit no acoustic sensation is perceived.

AnC—: At the closing of the circuit, when the auditory organ is under the influence of the anode (*An*), no acoustic sensation is felt.

AnD—: In the anodic duration no acoustic sensation.

AnOS: At the anodic opening, however, the same sound is heard as at the cathodic closing, but of less intensity (*S*), and less prolonged.

Brenner has also proved that the reaction of the acoustic nerve is produced by the galvanic current directly affecting the nerve itself, and not through a reflex action from the trifacial, as supposed by Benedikt and others. To use besides the battery only a commutator and current selector for changing the number of elements, while the current flows uninterruptedly, is considered by Neftel a comparatively rough proceeding, or at least a very imperfect mode of treating the acoustic apparatus. It is more or less painful, and is not sufficient for diagnostic and therapeutic purposes. To make the galvanization of the auditory apparatus more exact, and very much milder, it is necessary to intercalate the rheostat† as an accessory circuit.‡

In Brenner's formula the number of elements is marked by Roman figures, and the numbers of resistances in the rheostat by Arabic.

The lower current intensities usually call for the murmurs, the higher ones for musical sounds. This harmonizes with the results of Helmholtz's researches, according to which the organs for the perception of murmurs are situated within the vestibule, and those for the perception of musical sounds in the cochlea.

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* Disturbance of course greatest at first.

† *Brenner's Stopper Rheostat.*—It consists of three metallic disks on a stand B, C, D. On the circle B, they are numbered by units or quantities from 0 to 10; on the circle C, by tens from 0 to 100; on the circle D, by hundreds from 0 to 1000. The resistance to the passage of the current is made by wires of different lengths, and it can be increased or diminished without breaking the circuit. A wire runs across the disks. To use the rheostat, connect one wire with the poles of the battery and the other wire with one of the electrodes. The radii from these disks are called stoppers, and when they are all at 0 there is no resistance; if at 10 it will make it equivalent to one more, or eleven elements (or pairs of cells of the battery).

‡ One of these rheostats, made in Berlin, we have in operation in our office, with a battery of twenty cups of zinc and carbon.

The following interesting case is reported by Dr. M. Meyer,* and shows the good effects of applying electricity for deafness in conjunction with other remedies.

"Carl M., aged nine years, a lively and smart boy, of a rather scrofulous diathesis, showed suddenly, in May, 1862, signs of difficult hearing, which alarmed his relatives, the more so as already several members of the family suffered from a similar difficulty. Dr. Ehrhard, being of the opinion that the trouble was a rheumatic affection, the examination of the ear showing no disease, ordered corrosive sublimate and baths of potash. After eight days the little patient could hear even a low conversation, musical sounds, rappings, etc.; however, the hearing was very slight. Iodide of potassium was then substituted, and the potash-baths continued. Now this peculiar symptom appeared, viz., that the baths had no action upon the skin, although in the first week they produced a copious diaphoresis. Yet the perception of spoken words improved while other sounds were absolutely unheard.

"The vibrating tuning-fork held against the skin produced no sensation; its application to the thorax caused the surprising discovery that there was an anæsthesia not only of the face, but also of the whole body, especially of the upper portion. As the continued administration of the above-mentioned remedies brought about no change, on the 14th of July, upon the advice of Privy Councillor Romberg, my aid was sought with regard to the application of electricity. One application of the electric brush to the face, forearms, and hands sufficed to remove the anæsthesia in its whole extent, and with it also to relieve the difficulty of hearing. The increased temperature of the skin following this operation, and the free perspiration now ensuing each time after the use of a potash-bath, caused in a short time a complete restoration of the sense of hearing, so that the patient could perceive both words and sounds as well as ever."[*]

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* Electricity in its Relations to Practical Medicine, by Dr. Moritz Meyer, translated by Wm. A. Hammond, M.D., New York.

The conclusions arrived at by Dr. Meyer in the use of electricity for many years are:

"1. The *interrupted* current is applicable in those cases in which we wish—

"(*a*) To excite the muscles, the nerves of sense, the sensory or the motory nerves.

"(*b*) To produce contraction of the blood or lymphatic vessels.

"(*c*) Or to affect certain organs supplied from the sympathetic.

"2. The use of the *constant* current is indicated in those cases in which we wish—

"(*a*) To excite the nerves of sense or the skin.

"(*b*) To destroy the outer skin or mucous membrane.

"(*c*) To produce an increase of warmth.

"(*d*) To induce a chemical process and also blood coagulation.

"In galvanizing a nerve it is advisable often to change the direction of the current, because the conductibility of a current flowing long in the same direction decreases, while with a change in the direction it increases."

Dr. Neftel[†] reports eight cases treated by the galvanic current, an abstract of which we give as follows:

CASE I. *Hyperæsthesia*[‡] *of the auditory nerve, with tinnitus aurium; catarrh of the middle ear, and hardness of hearing.*—There is no mention of improvement of hearing, but the most distressing of all symptoms, the noise, disappeared, and did not return.

CASE II.—Same condition of the acoustic nerve as in Case I., with noises and headache. Deafness in left ear from infancy, with anatomical lesions in the middle ear. Improvement of hearing and rapid cure of the noise in the head, and headache. His concluding words are: "I continue to treat the patient once a week; his hearing is normal; he has no headache, no noises in the head; and the noises in the ear are very slight, and disappear entirely after each galvanization." (Do they not, however, return?—for the writer has treated cases which he thought were cured, but the noises returned.)

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[*] Meyer, op. cit., pp. 342, 343.

[†] Op. cit., p. 67.

[‡] It reacts to a milder current longer and more powerful.

CASE III.—Same condition of the acoustic nerve as in the preceding cases; hardness of hearing of one ear and deafness of the other (no details given of hearing distance), a case of otitis media purulentia. Politzer's method of inflation was used. The conclusions are as follows: "I repeated the galvanic treatment daily during one week, the patient feeling remarkably well, the heaviness of the head, the tinnitus aurium, and discharges from the ear disappeared; even the ear-wax, the secretion of which had entirely ceased for many years, returned, and the hearing became normal."

CASE IV. Also a case of *hyperæsthesia,* with loss of the olfactory sense; tinnitus aurium, and hardness of hearing; return of the olfactory sense, and improvement of hearing.*—The following is the conclusion: "The noises have returned, but in so slight a degree that they do not interfere with his irritable disposition. After repeated treatment his hearing has much improved [hearing distance not stated], and his olfactory sense is perfect." This is a remarkable case, as the results of Drs. Beard and Rockwell's treatment have been either negative or partial, and in no case complete.†

CASE V. *Tinnitus aurium, with two different noises; torpor of left acoustic nerve; hyperæsthesia of the right ear; left ear completely deaf; improvement of hearing after treatment, with disappearance of dizziness and one kind of noise.*—Neftel says: "The hearing has improved wonderfully, so that the lady is able to converse, and can hear such murmurs as, for instance, the scraping of a pen, etc., which formerly she could not at all perceive."

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* The excitability of the acoustic nerve may be either morbidly increased (Brenner's hyperæsthesia) or it may be greatly diminished (torpor of the acoustic nerve).

† Anosmia, or Loss of Sense of Smell. A Practical Treatise on the Medical and Surgical Uses of Electricity, p. 584. W. Wood & Co., New York, 1871.

CASE VI. *Facial paralysis of right side, with hardness of hearing.*—The treatment consisted in galvanization with proper precautions. In the course of a month the patient recovered from both the paralysis and hardness of hearing.

CASE VII. *Torpor of the auditory nerve, lasting from childhood, in a man aged sixty.*—Improvement of hearing after treatment.

CASE VIII. Also a case of *torpor of the acoustic nerve; total deafness in right ear for two years, and failure of hearing in the left.*—Immediately after the first treatment loud conversation could be heard with the right ear from a considerable distance. The hearing continued to improve.

Dr. Neftel concludes as follows: As can be seen from the foregoing cases, to which I could add a considerable number of others, the treatment of affections of the acoustic nervous apparatus is accomplished by the same means by which they have been diagnosticated.

Every unprejudiced observer will agree with the closing sentence of Brenner: "Henceforth a diseased ear cannot be considered fully examined, and the means for its cure exhausted, so long as for these purposes the galvanic current has not been used in a scientific manner."*

Dr. S. Moos† publishes the following remarkable case of recovery from nervous deafness, which we have condensed:

Miss S. D., aged nineteen, took a severe cold on February 9th, 1869, resulting in an attack of acute articular rheumatism, which run its usual course during four weeks. In the fifth week nervous (hysteric) symptoms appeared, which lasted until the seventh week, when they began to decline. At the end of the seventh week, the patient complained of a terrible pain behind the left ear. The organ of hearing was now very sensitive, every noise caused pain, and the acuteness of hearing was very great. In the eighth week reconvalescence seemed to set in. The sensitiveness of the organ of hearing decreased, accompanied by hardness of hearing, which increased to such a degree that at the end of the ninth week she was perfectly deaf, and it was necessary to communicate with her in writing. In the eleventh week, the patient became affected with hystero-epileptic attacks, with pains in the abdomen and back, loss of consciousness, tetanus, and at last clonic cramps. On the 3d of May, she complained for the first time of a severe pain in the brain, on the left side, accompanied by excessive hyperæsthesia of the scalp, which was decidedly unilateral. There was hyperæsthesia of the face, also unilateral, but not as painful as the scalp. On the 5th of May, he used a constant current of 5 Meidinger's elements to the sympathetic nerve of the neck for three minutes. On the 22d of May, the patient heard her own voice with her left ear, and the next day heard it with the right. From the 18th to the 24th of June, conductibility of the bones was noticed for the first time.

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* Neftel, op. cit., p. 81.

† Archives of Ophthalmology and Otology, vol. i., No. 2, p. 464.

On the 12th July, the hearing distance for the watch was, on the right, ten feet; on the left, nine feet. July 27th, she was sent to spend six weeks in the Black Forest. There she recovered completely.

Dr. Moos, in conclusion, says: "May this case toll the funeral knell for all those opponents of a therapeutic agent which, when employed according to proper indications, may yet prove a rational and grateful means not only for certain muscular and nervous affections, but also for some ear diseases, though their number mây be limited!"

Each individual operator prefers a special battery. We are in the habit of using zinc and carbon elements, so as to introduce into the circuit any number. The conducting wires being well insulated, we have a current-selector, so that we can increase or diminish its intensity by adding or removing any number of elements. To produce the current density, by introducing resistance, we employ Brenner's rheostat, which we have already described, by means of which from ten to twenty-one thousand units of resistance can be introduced into the accessory circuit. There is also a commutator, by means of which the direction of the current can be reversed; also a galvanometer, indicating the direction, its approximate intensity, its constancy, and fluctuation.

Brenner* details eleven cases of diseases of the ear treated by the galvanic current.

"In one case of thickening of the drum, the current caused absorption.

"In one case of hyperæsthesia, with tinnitus aurium and anatomical changes in the middle ear, the tinnitus was rapidly cured.

"In one case of hyperæsthesia, after the use of quinine, there was recovery.

"In one case of hyperæsthesia, with tinnitus aurium and catarrh of the middle ear, the tinnitus was cured.

"In one case of obstinate subjective symptoms of various kinds, there was improvement under great difficulties of application.

"In one case of noises in the head and ears of ten years' standing, with important anatomical changes in the ear, there was improvement.

"Of deafness, two cases were improved, one was much improved, and one was cured. The case which recovered was one of facial paralysis, with anomalous reaction of the auditory nerves.

"In all the cases there were anatomical changes. In some cases the treatment was quite persistent."

Case of nervous deafness tested by Brenner's formula; no improvement in the noises or the deafness.—Miss E. G., aged thirty-five years; has been healthy, but of an extremely nervous and sensitive temperament. Is in business, but owing to her deafness it is almost broken up. The deafness has continued to increase in spite of prolonged treatment under a number of physicians; also has constant noises in both ears. (No cause except catarrh.)

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* Op. cit., Band i. 2 Abth. p. 233, et seq. Brenner also mentions the fact that he failed in seventeen cases of tinnitus, loc. cit., p. 235, Medical and Surgical Electricity, Beard and Rockwell; Wm. Wood & Co., New York. Also R. Brenner's Researches and Observations in Electro-Therapeutics. On the Effects of the Electro-Current on the Auditory Apparatus in Healthy and Diseased Conditions. An attempt at founding a system of Rational Electro-Oteatrics. Leipzig, 1868.

Left ear, July 31st, 1871. Acuteness of hearing for speech very much diminished; requires to be spoken to in a very loud voice.

Ordinary watch cannot be heard on left side; meatus, membrana tympani, and orifices of Eustachian tubes normal; voice not natural; loud-ticking watch was heard on right, two inches; tuning-fork best on the left.

External arrangement of conductor on external ear, without water in the meatus, and without rheostat; no impression with 5—10—20—40 cells. With warm salt and water in the meatus with rheophore and the rheostat, the following was the unsatisfactory results:*

July 24th, 5 P.M.

20 cells,	Ka in ear.		
"	20	resist.	
"	30	"	K cl, bells and hammer, but do not remain.
			K o.
			A o.
			A cl, hammer.
			A Dur, "
"	40	"	K o, "
20 cells,	50	resist,	bell and hammer, both.
			K cl, hammer.
"	60	"	no reaction.
"	30	"	"
"	100	"	K cl, hammer.
			K D, "
"	200	"	"
15 "	150	"	"
20 "	30	"	K cl, sounds.
			K D, confusion.

July 27th.

20 cells,	0		no reaction.
"	10	resist.	
"	50	"	K cl, slight sound of hammer.
			K D, no sound.
			An d, "
"	60	"	K cl, slight sound.
			An D, " "
			An O, " "
			A cl, no sound.
			An D, no sound.
			K cl, "
20 cells,	70	resist	K cl, slight sound.
			d, no sound.
			Ano, "
			cl, twice.
			d, no sound.
"	100	"	K cl, slight sound.
			A cl, "

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* In the table, a, means anode; k, kathode; o, opening; cl, closing; d, duration.

July 31st, 1871, 5 P.M.

	K, in left ear.	20 cells, 20 resist	K cl.
	A, in hand.		K d.
20 cells, 10 resist	K cl.		K o.
	K D.		An cl, slight sound of hammer.
	K O.		An d.
	An cl.		An O.
	An d.	" 30 "	K cl.
	An O.		An cl.
	K d.		An d.
	K o.		An O.
	An cl.	20 cells, 100 resist	An cl, sound, bell.
	An d.	" 210 "	K cl, hammer.
	An o.	" 220 "	K cl, no results.
20 cells, 40 resist	K cl.		K d, "
	K d.		K o, "
	K o.		

Case of nervous deafness, the result of gout, tested by Brenner's formula, with no noise in ears.—A gentleman of leisure, of good family, aged forty, predisposed to hereditary gout, and of nervous temperament, began to become deaf without any apparent cause. In about three years there was complete deafness on one side, and insensibility to any sounds, except those spoken directly in front of the ear, on the other side. An ordinary watch not heard ticking in contact with the ear. An ordinary tuning-fork not heard by bony transmission, though a very large one could be heard on the best side; and by trying a number of them varying in pitch, some of the higher ones could be heard more readily than others. The worst side was apparently insensible to sound of any kind, until the vibration of large tuning-forks was intensified by means of Helmholz's attuned metallic resonators placed in the ear, which induced sensation of sound in each instance, but not sufficiently distinct to distinguish their musical character. No tinnitus aurium in either ear at any time.

General health tolerably good, but some nervous debility and mental depression on account of the infirmity. External meatus healthy in color, and curvature normal, but exhibiting a gouty concretion below handle of malleus; tympanic membrane, Eustachian tubes, and their pharyngeal orifices normal in every respect.

The best ear responds promptly to Brenner's formula for the normal acoustic reaction to the electric current. No sonorous reaction whatever, normal or abnormal, on the part of the worst ear, although as many as thirty cells were intercalated in the circuit, producing intense pain, not followed, however, by any after-effects, good or ill.

The large trumpet (Fig. 14) permits the patient to hear ordinary conversation, with some effort, as the sounds are confused by the resonance of the instrument.

Treatment with strychnia, internally, one-sixteenth of a grain, and locally, by the electric current, negative in a strictly professional sense, though the patient and his family claim some slight improvement from it.

CHAPTER XIX.

DEAF MUTISM.

THE term "*Deaf and Dumb*," or more properly "Deaf Mute," is applied to a person born deaf, and therefore unable to speak. Of deaf mutes there are two great classes:

1st. Those who are congenitally deaf, or have never spoken.

2d. Those who become deaf before the fourth or fifth year, but who have spoken. These are the "semi-mutes," and constitute one-half of the whole number of deaf and dumb. Many so-called deaf mutes are as intelligent and bright as persons possessed of all their senses. The deaf mutes of our day have many advantages over those of the last century, as they are now taught conventional signs in the schools devoted to that object, the alphabetical signs, the articulation of sounds, reading and writing, and reading on the lips. The boys are taught various trades, whilst the girls are instructed in plain sewing, dress-making, and domestic employments. History informs us that so-called civilized and refined people, such as the Egyptians, Greeks, Hebrews, and Romans, looked upon the deaf and dumb as allied to the brutes. We are told that in some portions of the East even at the present day they are obliged to perform the hardest and most degrading duties. "It was reserved for Christianty," says Wilde,* "to conceive the noble idea, and for modern genius and perseverance to perform the exalted work, of developing the faculties of the unfortunate deaf mutes, of giving to them the knowledge of good and evil, of rendering hem independent, and of awakening within them feelings and aspirations which, but for the beneficial enlightenment of education, would forever have remained unknown to them."

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* On the Physical, Moral, and Social Condition of the Deaf and Dumb, by W. R. Wilde, M.D. London, 1854.

They were the special objects of Christ's miraculous love, and we find many striking examples of it in the New Testament, but none more so than in St. Mark:* "And they bring unto him one that was deaf, and had an impediment in his speech; and they beseech him to put his hand upon him. And he took him aside from the multitude, and put his fingers into his ears, and he spit, and touched his tongue; and looking up to heaven, he sighed, and saith unto him, Ephphatha, that is, Be opened. And straightway his ears were opened, and the string of his tongue was loosed, and he spake plain."

The first practical attempt to teach the deaf mute was made by Petro de Ponce, a Benedictine monk, at Sagahun, about the middle of the sixteenth century. He taught the two mute sons of a Castilian nobleman. But it is to the Abbé de l'Epée, of France, that the deaf mute is most indebted, as he devoted his whole life and fortune to devising his system of instruction, which he brought to great perfection in the "Royal Parisian Institution." He was born November 12th, 1712, and died 1789.

"It is stated that a casual circumstance drew his attention to the education of the deaf and dumb. Calling on a lady one day on business, he was told that she was not at home. Being invited to walk in, he entered the house and found two young females occupied in needle-work. Making the usual salutations, he was surprised at receiving no reply. While wondering at what appeared to him a want of politeness, their mother came in and solved the mystery, by informing him her daughters were deaf mutes. His heart was filled with compassion for them when he thought of their isolated condition. He gave himself up to devise some plan by which their condition could be ameliorated. An ecclesiastic named Vanin had commenced instructing them. Death removed him, and their condition appeared hopeless when De l'Epée appeared. He invited them to come daily to his abode, and from this time he dedicated his life to the cause of the deaf and dumb. He reflected that savages of different languages were able, by means of signs, to communicate to a certain extent with each other.*

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* St. Mark, vii. 32–35.

"It struck him forcibly that signs were the natural language of the deaf and dumb. He adopted them as his plan for instruction, enlarged and improved them, and reduced them to a system. But his precious life was too short to complete it. Fortunately, he had instructed the Abbé Sicard, and when on the 23d of December, 1789, he was called, in the seventy-seventh year of his age, from time to eternity, there survived a man worthy to succeed him.† This venerable Christian had aroused public attention to the wants of the deaf and dumb, had vanquished the prejudices that existed against them, and had called forth a generous sympathy in their behalf. They became the objects of public benevolence and private beneficence. Numerous schools were founded for them. Pious, learned, and capable teachers arose to instruct them.

"The most eminent of these was Roch Ambroise Cucurron Sicard. He was born at Fousseret, near Toulouse, on the 20th of September, 1742. He was educated in that city, and on the completion of his studies entered into holy orders.

"The good and learned Archbishop of Bordeaux sent him to

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* "Major Long, in his Expedition to the Rocky Mountains (Philadelphia, 1823, vol. i. p. 578, etc.), gives upwards of one hundred Indian signs. Among which are 'Man, finger held vertically.' 'Sun, the forefinger and thumb are brought together at the tip so as to form a circle, and held up toward the sun's track. To indicate any particular time of the day, the hand with the sign of the sun is stretched out toward the east horizon, and then gradually elevated, to show the ascent of that luminary, until the hand arrives in the proper direction, to indicate the part of the heavens in which the sun will be at the given time.' 'Fire, the act of striking fire with the flint and steel is represented, after which ascent of the smoke is indicated by closing the fingers and thumb of the right hand, holding them in a vertical position with the hand as low as convenient, the hand is then gradually elevated, and the fingers and thumb a little expanded, to show the ascent and expansion of the volume of smoke.'

"Indians, on several occasions, visited the Pennsylvania Institution for the Deaf and Dumb, and were able to hold a conversation with the pupils by signs."—*Memorial of A. B. Hutton, by James J. Barclay, Esq., Secretary Pennsylvania Institution.*

† He deprived himself of the comfort of fuel for a whole winter, in order that he might have larger means to aid the deaf and dumb.

Paris, and had him placed under the instruction of De l'Epée. He soon entered enthusiastically and energetically into the views of his master, the value of which he was not slow to perceive and appreciate. Endowed with a vivid and fertile imagination, he had remarkable skill to clothe abstract ideas with sensible forms; he had a peculiar talent for pantomime, which is the appropriate language of deaf mutes. Gifted with a pliant and active spirit, he eagerly sought and discovered new and varied means to express and explain his ideas or his precepts. It seemed that to teach the mute was his natural vocation, so admirably was he qualified for it. Adopting the fundamental principles of De l'Epée, he seized, above all, this primitive idea,—that the instruction of deaf mutes was a translation, that mimic signs was their mother tongue, that the conventional language of society was to them a foreign one, which, by the aid of translation, might be taught them. He reproduced this idea under new forms; he reflected upon it incessantly. The language of signs became to him a natural language; so much did he love it, and so skillful was he in its use, that he not only used it, but he enlarged it, enriched it, moulded and remoulded it."

"Sicard, now admirably trained to teach, was recalled from Paris by the Archbishop of Bordeaux, and placed at the head of the school established by him.

"Sicard's fame as an instructor soon spread, and his success rendered him celebrated, and gained him clerical advancement. He was made Vicar-General of Condom, and a canon of Bordeaux."*

In 1760, Samuel Heinicke,† of Germany, developed the "Artificial Method," which had for its principal aim the development of the power of speech, which exists in all save a few deaf mutes, and the training of the eye of the mute to interpret the duty of the ear. This is now called the "German Method." In England, the first person who conceived a plan for instructing the deaf mute was Dr. John Wallis, Professor of Mathematics in the University of Oxford. In

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* Memorial, op. cit.

† Heinicke, a Saxon by birth, born in 1723, and died in 1790.

1662 he exhibited to the Royal Society his first pupil. Thomas Braidwood opened a school on the system of Wallis, in Edinburgh, in 1760. From this sprang all the institutions of a like nature in Great Britain. In 1783 Braidwood removed his academy to Hackney, near London. He died in 1806, but his institution was continued by his widow and grandchildren until 1816. The work which, according to Wilde, gives the fullest account of his mode of instruction is "Vox Oculis Subjecta," a dissertation on the most curious and important "art of imparting speech and the knowledge of language to the naturally deaf and (consequently) dumb," with a particular account of the academy of Messrs. Braidwood, of Edinburgh, and a proposal to perpetuate and extend the benefits thereof, as published in London, in 1783, by an American gentleman whose son Braidwood had educated.

Articulation was one of the chief means employed at this academy, and it would appear that some success was attained in speaking by the pupils educated there. To assist in imparting a knowledge of vocalization, we are told that the master employed a small instrument composed of "a small, round piece of silver, a few inches long, the size of a tobacco-pipe, flattened at one end, with a ball as large as a marble at the other," for placing the tongue of the pupil in the right position. Soon after special instruction was provided by the government and private benevolence.

In 1807, the deaf-and-dumb daughter of Dr. Cogswell, of Hartford, Conn., attracted the attention and enlisted the sympathies of the late Rev. Thomas H. Gallaudet, "a man who united the true principles of charity with distinguished scholarship and unwearied assiduity and patience."* He subsequently proceeded to Europe, in order to acquire the art of imparting instruction to deaf mutes; and having remained for some time a pupil under the Abbé Sicard, he returned to the United States, accompanied by M. Clerc, who was then (in connection with Massieu, the favorite pupil of Sicard) one of the mute assistants of the Parisian Institution.

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* Op. cit., Wilde.

“When Mr. Scixas retired (November 3d, 1821) from the Pennsylvania Institution for the Deaf and Dumb, M. Clerc, with the consent of the Directors of the American Asylum, took temporary charge of it.

“He reorganized it, introduced the method of Abbé Sicard, and gave instruction and advice to the assistant teachers until May, 1822, when he was recalled to Hartford, and was succeeded by Lewis Weld, the pupil of Gallaudet and Clerc.

According to Mr. Barclay, M. Clerc was remarkable for the grace with which he made signs. They were intelligible to those who were not familiar with the language of signs.

“In 1818 he was introduced to a young Chinese, who was alike unacquainted with the French and English. M. Clerc knew nothing of the Chinese. Yet, by means of signs, they were enabled to communicate with each other; and M. Clerc learned from his Chinese acquaintance “many facts respecting the place of his nativity, his parents, and their family; his former pursuits in his own country, his residence in the United States, and his notions concerning God and a future state.” By the aid of appropriate signs, M. Clerc ascertained the meaning of about twenty Chinese words.[*]

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[*] During the period when Mr. Dunn's Collection, the “Chinese Museum,” was in Philadelphia, a Chinese whom Mr. Dunn had brought to this city, and who attended at the Museum, often visited the Pennsylvania Institution for the Deaf and Dumb, and was enabled to hold conversation with the pupils by means of signs.

About two years ago, some Japanese students from Rutgers College visited the Institution, and one of the older boys conversed with them without difficulty, in signs, to the great interest and pleasure of the visitors.

While Mr. Stansbury, formerly of the New York Institution, was in St. Petersburg, he visited the Institution for the Deaf and Dumb in that city. He knew nothing of the Russian language. He told a short story, in signs, to the pupils, who immediately wrote it on their slates.

In 1819, while Mr. Gallaudet was at Cornwall, Conn., he had an interview with a number of young persons from the South Sea Islands, and from different tribes of North American Indians. He held an interesting conversation with them in the language of signs. A number of questions were asked and correctly answered, and the meaning of a number of Owhyheean words ascertained. It appeared that not a few of the signs used in the instruction of the deaf and dumb were the same as those used by the South Sea Islanders, to supply the deficiency of, or give emphasis to, their own comparatively defective language.

"Advancing years rendered the labors of teaching too onerous for M. Clerc, and after forty-one years of arduous duty, he retired from the chair which he had so long and so ably filled. His valued services were not forgotten by the directors of the asylum."*

At the time a silver pitcher and salver were presented to Mr. Gallaudet, a like memorial of affection was also presented to M. Clerc.

Mr. Lewis Weld discharged his various and important duties in a manner highly satisfactory to the board and advantageous to the pupils, until October, 1830, when, on the resignation of Mr. Gallaudet, he was invited to take charge of the American Asylum, the scene of his early labors.

When Mr. Weld retired from the Pennsylvania Institution, in 1830, Mr. Hutton† was appointed his successor.

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* Memorial, op. cit.

† ABRAHAM B. HUTTON, ESQ.—The object of this notice, although not a medical man, was so associated with medical matters in his capacity of principal of the Pennsylvania Institution for the Instruction of the Deaf and Dumb, that a short notice of him is considered proper.

Mr. A. B. Hutton was born in Albany, New York, September 10th, 1798, and received his literary instruction at Union College, where he graduated in 1817. Subsequently he entered as a student in the Theological Seminary at Princeton, New Jersey, in 1819. Owing to an affection of his throat he was obliged to relinquish the study of divinity. In March, 1822, he entered the Pennsylvania Institution for the Deaf and Dumb as an assistant teacher. In this capacity he gave such entire satisfaction that, when Mr. Lewis Weld, the principal, was called to take charge of the American Asylum for the Deaf and Dumb, at Hartford, Mr. Hutton was appointed, on the 4th of September, 1830, as his successor.

Mr. Hutton possessed all the requisites for his new position, having a cultivated mind and refined taste, with gentleness and firmness combined, also great aptness in teaching. His attainments in natural philosophy, mechanics, and chemistry were very considerable, and he took great pleasure in lecturing on these subjects, both to the advantage of the pupils and the entertainment and instruction of the numerous visitors at their weekly exhibitions. But everything was subservient to the great object of his life,—the successful instruction of the deaf mute. To this subject he devoted all his energies, and was alive to every improvement. The success with which his labors were crowned, and the thorough appreciation of his efforts by the managers of the institution, his friends, and the community at large, are the best evidences of his ability and fidelity.

For several years he suffered from an affection of his kidneys, and yet he was always at his post. In the spring of 1869 the disease increased, but

"He made himself master of the science of instructing the deaf and dumb. After a full and careful examination of the two systems of instruction, he became convinced of the superiority of that of signs with its auxiliaries, dactylology, writing, etc., over artificial articulation and lip-reading, and found no reason to suggest any alteration of the Sicard system introduced into the Institution by Clerc. That system he pursued to the close of his life, fully satisfied that it was the best system. His large experience and ripe judgment entitled his opinion to great consideration. For upwards of forty years he discharged the arduous duties of principal with great success and fidelity.

"Laurent Clerc died a few months ago (1870), at the age of eighty-three, much respected by a large number of pupils, who are scattered all over this country."*

The first institution for the instruction of deaf mutes in the United States was opened at Hartford in 1817. Since then the number has increased to thirty, and the interest in the good work has also increased in the same proportion. It is known that there is now (1870) one deaf mute in every two thousand of the whole population of the United States. According to the census of 1870, the population of Pennsylvania is three million five hundred and eleven thousand five hundred and forty-three, which, by the above ratio, will give seventeen hundred and fifty-five as the whole number of deaf mutes of all ages in the State. The number of annual births in the United States being in the proportion of about one to twenty of the population, we may safely assume eighty-eight as the number born or made deaf yearly in Pennsylvania.†

The semi-centennial anniversary of the Pennsylvania Institution took place February 28th, 1871, and we had the

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he did not leave the city until July, 1870, when he made a visit to his sister, and soon after died on the spot where he always wished to die, ministered to by the affectionate hands of those he loved.

The directors of the Pennsylvania Institution, feeling great confidence in the experience, ability, zeal, and high moral character of Mr. Joshua Foster, have elected him principal, to fill the place of the lamented Mr. Hutton.

* Mr. Barclay's Memorial.

† Report of the Pennsylvania Deaf and Dumb Institution, 1870.

privilege of enjoying the gathering of the pupils from all parts of the country, and the pleasure which they took in this interesting occasion, with their success in getting up a variety of amusements. We were informed that the number of deaf mutes who have enjoyed the privileges of the institution since its commencement, fifty years ago (including the present inmates), is nearly fourteen hundred.

In their last Annual Report,* the directors stated their intention of introducing more systematic instruction in articulation. For this purpose, they appointed Miss Rebecca H. Cropper; and to prepare her fully for the situation, they were, through the considerate kindness of the principal and directors of the New York Institution, enabled to place her under the tuition of Mr. B. Englesman, whose reputation as an instructor in this art deservedly stands very high. After remaining under his instruction for two months, she returned to this city, and at the commencement of the present term began a course of teaching the semi-mutes. "Sufficient time has not elapsed to enable the directors to speak decidedly on the subject, but nothing has occurred to change the opinion they have already expressed. In their last report they gave not only their own, but the views of Dr. Kitto, Dr. Peet, Rev. Dr. Day, Mr. Weld, the Rev. Mr. Turner, Mr. E. M. Gallaudet and Miss Montgomery. They now add an extract from a letter, dated Doncaster, August 20th, 1870, to the secretary, from the able and experienced head of the Yorkshire Institution for the Deaf and Dumb, Charles Baker, Esq.:

"You are aware that the Braidwood family made this [articulation] their vehicle for the instruction of their pupils, so that my earliest predilections were in its favor; but, so early as 1815, it was stated in one of the reports of the Institution at Birmingham, that 'the children are taught to read and write, and in some instances to speak.' We, therefore, conclude that, in those early days, the teaching of articulation was the exception. When I became a resident of that institution, in 1818, there were only three cases of pupils who could articulate, and they were with difficulty understood.

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* Pennsylvania Institution for the Deaf and Dumb. Philadelphia, 1870.

The general instruction was carried on by signs and spelling on the fingers, with writing and other auxiliaries. There is no institution in these islands where speech is made even a principal mode of conveying instruction, and probably not one in which it is not partially cultivated. In the London Asylum, signs, pictures, the manual alphabet, and the usual means adopted elsewhere, are all employed; at the same time it puts forth articulation as its chief basis.

"At Donaldson's Hospital, Edinburgh, professedly an institution for teaching by means of speech, all the other means are resorted to. None of the other institutions in this country profess to make speech their basis, but I have reason to think that in all of them semi-mutes and the semi-deaf have the power of speech carefully cultivated; and this is our case. I have always two or three pupils who read vocally, and whose reading is well understood by those accustomed to them, and also by strangers, after they have listened for a time, and overcome their monotony and faults of pronunciation. Nothing that I have ever seen or read on the subject would induce me to give up the substantial advantages which our pupils derive from the modes of instruction we pursue for the illusory benefits which it is supposed articulation, with reading on the lips, would confer on them. We know that a solid foundation is laid, and that constant and uniform improvement will follow under moderately favorable circumstances in after-life, and I would not renounce such solid advantages for the showy and adventitious acquirements, so liable to fall into disuse, which speech offers. In the course of my long experience, I have met with but two instances of deaf mutes having acquired speech who have persistently used it for common purposes, while I know of hundreds who have preferred the manual alphabet and writing as the *readiest* way of making themselves understood.

"Doubtless in a large institution where articulation is made a regular branch of study, a few may be found who will make the acquisition, but these will be very rare instances, and the time required must sadly interfere with the ordinary curriculum of the institution, for which the pupils thus engaged must inevitably suffer. I would suggest, in order to complete the education of such a class, that, provided their improvement warrants it, a seventh year should be added to their course. Such an exception your directors could authorize."

The following remarks have been furnished by Mr. Atherton Blight, a member of the Board:

"At my visit to the Institution for the Deaf and Dumb, in London, I made particular inquiries of the principal with regard to the subject of articulation. He told me that in cases of semi-mutes, where the children had their hearing at birth, but lost it a few years afterwards, they endeavored to do all in their power by special instruction to nurse and improve the germ of capacity for speaking which each child might possess. He, in common with the large majority of teachers in Great Britain, considered it a hopeless task to attempt to teach articulation to children who were born deaf.

"The sign language, he assured me, was almost universally taught in Great Britain.

"Upon attempting to converse with one of the women teachers who was introduced to me as the best example they had of a mute who could articulate, it was with great difficulty that I could understand a single word.

"I also visited the Dutch Jewish school, for the special purpose of teaching *articulation;* together with another gentleman, I examined several of the children very carefully, and we both came to the conclusion, from the examples of one or two years' standing, that, except in the case of a bright, intelligent semi-mute, the task was utterly fruitless and hopeless."

The following is a list of thirty-three of the thirty-four institutions in the United States, with their locations, chief executive officers, and number of pupils, from the Tenth Annual Report of the Columbia Institution, June 30th, 1867, with such additions and alterations as to bring the record up to 1871:

Institutions for the Instruction of the Deaf and Dumb in the United States.

	NAME.	LOCATION.	Date of opening.	CHIEF EXECUTIVE OFFICER.	Number of teachers.	Number of pupils during year last reported.
1	American Asylum	Hartford, Conn.	1817	Edward C. Stone, M.A., principal	11	260
2	New York Institution	New York City	1818	Isaac L. Peet, M.A., principal	19	479
3	Pennsylvania Institution	Philadelphia, Penn.	1821	Joshua Foster, principal	9	230
4	Kentucky Institution	Danville, Ky.	1823	J. A. Jacobs, M.A., principal	4	80
5	Ohio Institution	Columbus, Ohio	1829	Gilbert O. Fay, M.A., superintendent	8	180
6	Virginia Institution*	Staunton, Va.	1839	John C. Covell, M.A., principal	3	47
7	Indiana Institution	Indianapolis, Ind.	1844	Thomas McIntire, M.A., superintendent	8	182
8	Tennessee School	Knoxville, Tenn.	1845	Joseph H. Ijams, B.A., principal	3	61
9	North Carolina Institution*	Raleigh, N. C.	1845	Willie J. Palmer, M.A., principal	3	41
10	Illinois Institution	Jacksonville, Ill.	1846	Philip G. Gillet, M.A., principal	10	282
11	Georgia Institution	Cave Spring, Ga.	1846	W. O. Conner, principal	2	35
12	South Carolina Institution*	Cedar Spring, S. C.	1849	J M. Hughston	2	22
13	Missouri Asylum	Fulton, Mo.	1851	W. D. Kerr, M.A., superintendent	5	57
14	Louisiana Institution*	Baton Rouge, La.	1852	J. A. McWhorter, M.A., superintendent	2	54
15	Wisconsin Institute	Delavan, Wis.	1852	George S. Weed, M.A., principal	5	91
16	Michigan Asylum*	Flint, Mich.	1854	Egbert L. Bangs, M.A., principal	6	124
17	Iowa Institution	Iowa City, Iowa	1855	Benjamin Talbot, M.A., principal	4	96
18	Mississippi Institution	Jackson, Miss.	1856	(Buildings destroyed by fire in 1864)†	...	.....
19	Texas Institution	Austin, Texas	1857	J. A. Van Nostrand, M.A., principal	2	27
20	Columbia Institution	Washington, D. C.	1857	Edward M. Gallaudet, M.A., president	9	118
21	Alabama Institution	Talladega, Ala.	1858	Joseph H. Johnson, principal	1	29
22	California Institution*	San Francisco, Cal.	1860	Warring Wilkinson, M.A., principal	1	37
23	St. Bridget's Institution (Catholic)	St. Louis, Mo.	1860	Sister Stanislaus, principal	1	25
24	Kansas Institution	Olathe, Kansas	1862	Lewis H. Jenkins, principal	2	20
25	St. Mary's Asylum (Catholic)	Buffalo, N. Y.	1862	Sister Mary Ann, superintendent	4	54
26	Minnesota Institution	Faribault, Minn.	1863	Jonathan L. Noyes, M.A., superintendent	1	27
27	Institution for the Improved Instruction of Deaf Mutes	New York	1867	F. A. Rising, principal	3	26
28	Arkansas Institute	Little Rock, Ark.	1867	Elmore P. Caruthers, M.A., principal	3	36
29	Maryland Institution	Frederick City, Md.	1868	Charles W. Ely, M.A., principal	5	88
30	Nebraska Institute	Omaha, Neb.	1869	William M. French, principal	2	21
31	West Virginia Institute	Romney, West Va.	1870	Horace H. Hollister, M.A., principal	2	22
					123	2005
32	National Deaf-mute College‡	Washington, D. C.	1864	Edward M. Gallaudet, M.A., president	5§	§53
33	Clarke Institution for Deaf Mutes¶	Northampton, Mass.	1867	Miss Harriet B. Rogers, principal	6	49

The college referred to in the list of institutions is a distinct organization of a national character within the Columbia Institution, with a primary department, and a full college faculty, under the presidency of Edward M. Gallaudet, M.A., a son of the late distinguished Rev. Thomas H. Gallaudet. It was organized in 1864, and bids fair to further high intellectual development in deaf mutes, so as to fit them to become teachers in other institutions. Another son of this worthy gentleman is rector of St. Ann's Church, New York, a church in which the mute language is employed, and at which they can receive all the rights and privileges of our holy religion.

"The three graduates of Columbia College of last year (1869) were all quickly provided with suitable employment. Two have been appointed instructors in other institutions for the deaf and dumb; but, in addition, one of them has received a commission to prosecute researches with the microscope, in which he is a great adept, while the third has entered the patent-office, in the service of the government, and become an assistant examiner.

"It is expected that as authors, editors, scientific investigators, as well as in other walks of intellectual life, this class of men, hitherto almost wholly excluded, and ranked as pariahs, may, some of them, soon rise to the position of leaders."

It may be well to introduce at this place a notice of another effort for the deaf and dumb at Pittsburg, Pennsylvania.

"Into a mission Sunday-school connected with Dr. Brown's church there strayed sometimes a little colored deaf mute; though often dismissed, he as often returned, and this was looked on as a providential indication that some pains should be taken to have him instructed. An educated deaf mute was found, who undertook to become the boy's teacher. Then it was determined that, as there was a competent teacher, a class of deaf mutes should be collected, and, the number both of scholars and teachers increasing, a separate room was obtained for their accommodation, and ultimately a day-school was organized as a part of the common school system of the city."* It opened in September, 1869, and has now (1871) thirty-two pupils taught by the sign language.

Besides the two great classes which we have enumerated in the beginning of this chapter, there is still another small division into "dumb but not deaf," or dumb only. The majority of these "dumb only" prove, on examination, to be idiotic, paralytic, or both.

Localities seem to exert some influence in the matter of deaf mutism, as more congenital cases are from the country; but those who become dumb after birth are most common in cities and towns, thus showing the deleterious influences of cities.

Climate has a certain influence, more especially in low damp valleys, like those of Switzerland, where we find the largest number of deaf mutes compared with population. Belgium, on the contrary, contains the smallest proportion of deaf mutes, and this is accounted for by its flatness, and the great fertility of its soil. In regard to the sexes in our American institutions, the proportion is—males, 124; females, 102. In the Irish, in the investigations of Dr. Wilde, he gives the proportion of 100 males to 74·61 females in the congenital; while in the acquired, or semi-mutes, the proportion is 100 males to 91·46 females. Certain writers have asserted that the organs of speech in deaf mutes are either malformed, or from want of exercise are undeveloped; but this has been proven by recent observers not to be so. Among the chief predisposing causes of congenital deaf mutism is the close relationship or consanguinity of parents. This matter has been set at rest by the results of the Irish census, for in 154 cases, where the parents were related in the degree of first, second, or third cousins, the results of these intermarriages were 100 cases; 86 congenital and 6 acquired deaf mutes, and 4 of these were dumb only, and 4 were dumb and idiotic.

The following interesting facts are furnished by Mr. Joshua Foster,† and were obtained by an examination of the records of the Pennsylvania Institution for the Deaf and Dumb at Philadelphia. The number of families in which more than one of the children is deaf and dumb appears to be one hundred and forty-seven:

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* America and the Americans, by W. G. Blaikie, D.D., Sunday Magazine.

† Principal (Report for 1870, p. 34).

Families in which there are		two	children	deaf and dumb	98
"	"	three	"	"	36
"	"	four	"	"	9
"	"	five	"	"	3
"	"	six	"	"	1
				Total	147

In five of these families both parents are mutes. In one the mother is a mute, and has had two husbands, both hearing. She had a daughter by each husband, both of whom are "deaf and dumb."

The number of deaf mutes who have enjoyed the privileges of this institution since its commencement, fifty years ago, is (including the present inmates) nearly fourteen hundred.

"From laryngoscopic examination of twenty deaf mute children, from eight to fourteen years of age, Prinz* arrives at the following conclusions: 1. Mobility of the muscles which open and close the larynx existed, and the power of vibration of the cords was perfect. 2. From deficient control on the part of the ear a perfect adaptation of the cords did not always follow the attempt to pronounce a vowel, but after instruction this improved. 3. In most of the cases there was a slight catarrh of the cords, referred, by Prinz, to a strain from using unnecessary force."

Many deaf mutes have married and reared families of children; a number of the men have married hearing women, and several of the girls have been married to hearing men; but most of them have prefered partners who were, like themselves, mutes. The children of these parents in most cases hear and speak; where there are exceptions to this rule, it is believed that both parents have almost invariably been congenital mutes.

It has also been asserted that deaf mutism is an infirmity of the poor, the result of their unhealthy dwellings, bad and insufficient food, impure air, want of clothing, and other causes which elicit scrofulous manifestations. But if this were the case we would find more mutes in the cities than in the rural districts.

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* Archiv f. Heilkunde, iv. p. 413. Transactions of the American Otological Society, p. 13, 1870. New York, D. Appleton & Co.

Almost all deaf mutes have a certain amount of hearing; and Itard makes the following division:

1st. Those that can hear the human voice as sounds, but are unable to distinguish words, amounting to about one-tenth of the whole.

2d. Those who can distinguish loud noises, such as clapping the hands, the ringing of bells, thunder, cannon firing, etc., who amount to five-tenths.

3d. Those who are completely deaf, numbering about four-tenths of the whole.

They are all, however, particularly sensitive to vibration or jar. Thus, in the Imperial Deaf and Dumb Institution at Paris, the movements of the pupils are regulated by the beat of the drum. Also in the New York Institution, containing the largest number of mutes of any establishment in the world, there has been made a successful experiment of forming an alphabet of drum-taps, by which intelligence may be conveyed in the dark, or at considerable distance, to any number who had learned the alphabet.

Cases of mutism also occur in connection with blindness. The earliest record is that in St. Matthew, xii. 22: "There was brought unto him one possessed with a devil, blind and dumb, and he healed him, insomuch as the blind and dumb both spake and saw." Several cases have been brought to the notice of the medical world, as, per example, those of James Mitchell, Julia Brace, and the well-known Laura Bridgman.

TREATMENT OF DEAF MUTISM.

The treatment of the deaf mute is divided into—1st. Prophylactic. 2d. Medical. 3d. At home. 4th. In school.

The first important matter is to place the mute or semi-mute in the healthiest part of the country, free from dampness or any malarious emanations, where there is access to good and abundant food, warm clothing, healthful exercise, with cheerful company, and regulated gymnastic exercise.

2d. *Medical treatment.*—We are of the opinion that, as a general rule, congenital deaf mutism is not curable. If the child, however, has shown any signs of hearing, or has ever spoken, Wilde, and several good authorities, advise that every possible pains should be taken to keep up the articulation, whether heard by the child or not. The late Mr. Toynbee's treatment consisted in the use of trumpets, whereby the nervous apparatus may be gradually excited so as to become sensitive to ordinary sonorous undulations and external stimulants.

In cases where, by disease subsequent to birth, either the membrana tympani or the mucous membrane lining the tympanum has been thickened, counter-irritation over the mastoid process will aid the use of trumpets; and in those where the membrana tympani has been partially or wholly destroyed by ulceration, and where there is a constant discharge of mucus, pus, etc. from the surface of the tympanic mucous membrane, it is desirable to syringe the ears occasionally with a weak astringent, so as to prevent the membrane becoming ulcerated and the bone which it covers carious. The artificial drum, made of gutta-percha* (or a piece of wet cotton), may also be resorted to.

Triquet, not depending upon his own judgment in treatment, gives the competent conclusions of M. Valade-Gabel: "The deaf mute who presents the most favorable conditions for treatment is he whose accidental deafness has supervened at the age at which the child begins to hear and speak, and who still retains some faint evidence of hearing and speech. If the organic lesion, the first cause of the infirmity, be seated beyond the nerve centres; if the child be intelligent, and have no brother or sister in the same state as himself; if he be the child of healthy parents, who have no connection by consanguinity, and if he have never previously been under treatment, the chances of cure are numerous; and if all these conditions are met with in the same subject, the chances almost reach to a certainty. On the contrary, they decrease in value in proportion as one or more of those conditions are wanting, and when all are wanting we should entertain scarcely any hope."*

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* Toynbee on the Diseases of the Ear, by Hinton, p. 408. London, 1868.

Triquet agrees with this opinion of M. Valade-Gabel in every point, and we have already declared our own in the most positive terms. One word more. If the child has shown any signs of hearing and of speech, if deafness has come on in the first months of life under the influence of catarrhal or eruptive fever, hooping-cough, coryza, or angina, there can be no doubt that medical treatment should be resorted to at the earliest moment possible. But if the child has lost hearing while in the uterus, or after convulsions, brain fever, etc., if he has never given signs of hearing or of speech, however weak those signs might be, the chances of the success of treatment will be extremely uncertain, and we should not conceal that fact from the parents.

Triquet cites many instances of the so-called cures of deaf mutes which are to be found in the records of medical literature, but on account of certain defects of detail and their not being well authenticated it is not necessary for us to copy them. We will only refer to one case, which, coming from a gentleman of the highest authority in the profession and thoroughly qualified in this special department, is worth more than all the so-called "cured cases." Dr. Von Tröltsch, in the fourth edition of his work on the Ear, writes: "As a matter of course, medical treatment must be introduced as soon as possible with the systematic instruction. I could relate to you from my practice several cases in which deaf mutism was obviously prevented, or was checked, or caused to retrograde, when in a condition of development. For instance, there is under my treatment at present a child four and a half years old, who, from the first months of his existence, has suffered from a profuse discharge from both ears, and is conscious only of loud sounds. Until within a few months, when I saw him for the first time, he was able to produce only inarticulate barking and other sounds, which were unintelligible even to the mother, so that he was already properly considered a deaf-mute child. Under local treatment the profuse discharge from the ears soon decreased, and with the decrease of the discharge the child manifestly commenced to notice noises which were made around him, and especially the words of bystanders, and also made attempts to imitate what was said. These attempts were encouraged, and the child was employed as much as possible in speaking words and sentences. In this manner I succeeded not only in decreasing the degree of impairment of hearing, but after a few months the child possessed a tolerably distinct and at any rate quite intelligible language. Without these local applications, and the correct guiding care of those about him, the child would certainly soon have *been counted among the deaf and dumb*." The same affection of the ear which only makes an adult hard of hearing may deprive the child at the same time of language, and cause him to remain during his whole future life in a lower state of social and mental development.

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* Introduction à l'Étude médicale et philosophe de la Sourdemuteté. Paris, 1859.

Dr. Wm. Kramer, of Berlin, in his Aural Surgery of the Present Day, published by the New Sydenham Society, London, 1863, p. 136, gives the following case:

"Among the diseases of the middle ear, when the membrana tympani has been whole, I have found 'exclusively interstitial exudation,' a frequent concomitant, the removal of which, in a completely (acquired) deaf mute, produced such recovery of the hearing power in the right ear that the little patient heard and repeated all letters, syllables, words, and short sentences, which were spoken with the mouth closely applied to his ear; but he was not on that account fitted to receive education with children in the perfect possession of their senses, nor to be removed from the category of deaf mutes."

This is the class of cases for which public schools should be provided to teach them articulation.

A semi-mute improved by treatment.—Elizabeth Ann P., aged ten years, suffered from abscesses in her ears from the age of fifteen months, and deafness as a consequence. At the age of three years she was brought to the ear clinic of Howard Hospital. I made a careful examination, and directed a tonic course, also that she should be taught the sign language, and gave the hope that at the age of ten or twelve years she might be able to hear to a degree.

On March, 20th, 1869, she was again brought to me, when she was able to hear my watch, also her mother's voice when she placed her mouth over her ear, also heard sound of piano, etc.

Examination.—External meatus filled with dark secretion. Membrana tympani of both ears opaque; was not able to see the handle of the malleus. Eustachian tube of right ear filled with mucus, left ear very dry and narrowed. Throat irritable, tonsils had been removed; directed cleaning of the ear with syringe and alkaline solution, use of Politzer's air-douche, with iodine vapor and astringents to throat, the preparations of iron and cod-liver oil; also gave directions to cultivate her voice and articulation, watching her mother's mouth and the other members of her family, and to report further progress.

Several other cases have occurred in the author's clinic of young children with otitis externa and media which have not only recovered from the disease, but, by judicious after-treatment, have had their voice return and been saved from the fate of the deaf and dumb.

ON THE CONDITION OF THE EAR IN THE DEAF AND DUMB, AS REVEALED BY DISSECTION.

It is highly desirable that careful post-mortem examinations should be made of the ears of deaf-and-dumb patients, whose cases have been carefully noted during life, in order that the organ may be compared with the amount of hearing possessed by the patient.

Pathological investigations into the condition of the ear in the deaf and dumb have been of late years conducted so as to enable us to draw some general deductions as to the state of the ear in deaf mutes. The late Joseph Toynbee, F.R.S.,* gave the details of five dissections performed by himself, and followed them with a tabular view of the morbid appearances found in all the other dissections of similar cases that had been met with by him.†

"*Dissection* 1.—A woman, aged forty, deaf, and consequently dumb, from birth. For the last ten years of her life she was insane, and was confined in a lunatic asylum. The petrous bones were sent to Mr. Toynbee, immediately after the death of the patient, by the late Mr. Crosse, of Norwich.

"Right ear.—The meatus externus, membrana tympani, and tympanic cavity were in a healthy state. Labyrinth.—The anterior limb of the superior semicircular canal communicated with the vestibule, but was rather larger than natural, and its shape somewhat irregular. Examined as it passes inward, it was observed to terminate in a cul-de-sac, after having attained only half its usual length. The portion of bone in the situation usually occupied by the inner part of the canal was of an ivory whiteness, and could be distinctly distinguished from the surrounding bone. The greater part of the posterior semicircular canal was absent, its anterior and posterior extremities presenting two cul-de-sacs, half a line in length. The external semicircular canal, the vestibule, and cochlea were in a normal state.

"Left ear.—The superior semicircular canal is in the same incomplete state as that of the right ear.

"*Dissection* 2.—J. C., aged fifty, died from fever. He was born deaf, and had been educated as a deaf mute.

"Right ear.—Meatus externus in a natural state, excepting that one part of the osseous parietes was quite rough. Membrana tympani thicker than natural, and perforated, a small red polypus was attached to its dermoid layer. A membranous band connected the stapes, incus, and tensor tympani muscle. The osseous semicircular canals were large, but they did not contain any membranous tubes. The cochlea was in a normal state, as were also the tympanic muscles and nerves.

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* The Diseases of the Ear, by J. Toynbee, edited by Hinton. London, 1859.

† This table has been added to by Prof. S. Moos, M.D., of Heidelberg, who has collected twenty-nine additional cases.

"Left ear.—The osseous semicircular canals did not contain any membranous tubes. One of these osseous canals was so contracted as to admit of the passage through it of a fine wire only.

"*Dissection* 3.—R. B., aged sixteen, a girl, bright and intelligent. Her parents stated that she was born deaf; but the child, on the contrary, said that she had heard sounds. Her teacher thought the child's statement the more likely to be correct, as she pronounced many words according to their proper sounds. None of her relatives were deaf mutes. Upon making a careful dissection of each ear, no deviation from the normal condition could be detected in the meatus externus, membrani tympani, or tympanic cavity. The stapes adhered to the fenestra ovalis with its usual degree of firmness. The membranous labyrinth in the vestibule was healthy, as was also that in the semicircular canals, with this exception, that in the middle of the superior semicircular canal in the right ear was a quantity of otoconie (ear-crystals), which completely obstructed the tube.

"From the occurrence of an accident to the left ear, it was not possible to ascertain its condition.

"*Dissection* 4.—A boy, aged fifteen, who had been wholly deaf from his birth. No deviation from the normal state in either ear could be detected.

"*Dissection* 5.—For the opportunity of making this dissection, Mr. Toynbee was indebted to Dr. Ormerod, of Brighton. The ears were taken from a young woman deaf and dumb, with discharge from each ear. She died with tubercular inflammation of the brain.

"Right ear.—The membrana tympani was absent; the mucous membrane of the tympanum red, and of extreme thickness, so as to fill the whole of the tympanic cavity, and to conceal the stapes; the tympanum was distended with dark-colored blood. The petrous bone was so intensely hard that it could with difficulty be cut by the bone-forceps. The cochlea, to the naked eye, had a natural appearance, and when submitted to microscopic examination, no deviation from the normal structure could be detected, excepting in that portion of the lamina spiralis which is near to the vestibule. This, instead of being composed of a delicate osseous lamina, and a fine membrane, the two making a delicate septum between the scala tympani and scala vestibuli, presented a mass of solid bone, filling up the scala tympani, and concealing from view the membrana fenestra rotunda, the inner surface of which it wholly covered. The outer surface of this membrane could, however, be distinctly seen from the tympanic cavity, and it appeared natural. The semicircular canals contained more otoconie than was natural.

"Left ear.—The membrana tympani was absent. The mucous membrane of the tympanum thick and red, as in the right ear. The semicircular canals also contained more otoconie than natural, especially the posterior one, which, at its junction with the posterior limb of the superior canal, was wholly distended with crystals to the extent of half a line. The lamina spiralis of the cochlea was of a deep red color, and blood was effused in both scala. The part of the lamina spiralis near to the vestibule was in the same state as the same portion in the right ear."

In the subjoined tables the condition of the ears in deaf mutes, as revealed by various reported dissections, is shown. (See Tables.)

ing the lips has obtained such a degree of perfection that the director is able to deliver his Sabbath sermons with exhortation orally, in which the pupils of the higher class can take part.'

"The examination I was allowed to make of the attainments of the pupils in this institution was altogether unrestrained. I was requested to indicate what pupils should be examined, and, in two cases, I purposely selected those whose personal appearance led me to suppose they were rather below than above the average of intelligence. At my suggestion, the director dictated to a pupil a short account of the coronation of the Emperor of Austria as King of Hungary, which had occurred at Pesth a few days before. M. Deutsch held his hands behind his back and spoke in a whisper, without any special contortions of the mouth and without repetitions, the boy writing with great rapidity, sometimes finishing a word while his eye was already on the mouth of the director to catch what was to follow. My companion in the visit was a German professor under whose tuition I was studying in Vienna. He assured me that what was written on the blackboard was an exact transcript of what M. Deutsch had spoken, absolutely without mistake. I think I do not exaggerate when I say that this exercise was performed as rapidly as would have been possible had the boy been in the possession of his hearing, and could not have been more speedily accomplished had the communication between the teacher and pupil been by means of the sign language as used in our best American institutions.

"I happened to find in this institution a boy of ten years, from Baltimore, with whom I had been previously acquainted. He is one of three mutes in the same family, born totally deaf, and with his sister has been in the school of M. Deutsch about three years. This little child comprehended with considerable readiness simple words which I addressed to him in German, repeating them after me in a clear but unmusical voice, and wrote with quickness and precision the following, which was dictated to him at my suggestion by the director in German: 'This gentleman is from America, and when he returns to America he will see your dear parents and tell them o the tabular arrangement, made by Toynbee, we will add, from s,[*] the following, omitting the observations made upon monsters, as hemi- and anencephali:

RNAL R.	MEMBRANE OF THE TYMPANUM.	CAVITY OF THE TYMPANUM.	LABYRINTH.	NERVE.	NAME OF OBSERVER.
.....	....	The walls rough and uneven, fenestra rotunda and promontory wanting.	....	....	Schallgruber.
.....	....	Fenestra rotunda closed by bony material.	....	....	Ribes.
.....	....	Fenestra ovalis too narrow.	....	....	Römer, Otto.
.....	....	Stirrup wanting.	....	....	Deleau, Jr.
.....	....	The cavity of the tympanum filled with a mucous mass; no trace of any ossicles.	Vestibulum, cochlea, semicircular canals, and both fenestra wanting.	....	Montain, Saissy.
.....	....	....	The semicircular canals of both ears terminating blindly, not communicating with the vestibule.	....	Bochdalek.
.....	....	....	The interior half of the superior semicircular canal wanting; the posterior canal wanting completely.	....	Schallgruber.
.....	....	....	The semicircular canals preternaturally filled with bony substance.	....	Ilg.
.....	....	....	Semicircular canals thickened, hard as ivory, and developed at the expense of these cavities.	....	Bochdalek.
.....	....	Stirrup wanting.	Fenestra rotunda wanting.	....	Clarus.
.....	Thickened.	Malleus and incus of both sides atrophied; atrophy of the promontory on the right side, a bony process; from the plate of the stapes to both sides; anchylosis of the stapes; the eminentia pyramidalis wanting. On the left side the fenestra ovalis closed completely, by the atrophy of the stirrup, the arms of of which were no thicker than a hair.	The terminations of the new vestibuli and cochlea dissolved into a brownish pulp. On the left side the horizontal semicircular canal was wanting.	Neurilemmaon both sides thickened; the soft oleaginous substance wanting.	Hyrtl.
....	On the right side, smaller than normally, but three times the thickness.	On the right side, the base of the stapes no larger than the os Sylvii; fenestra ovalis contracted.	On the right side, only one turn and a half to the cochlea, the others running together into a common cupola, into which the atrophied modiolus projected; the spiral lamina entirely wanting; the semicircular canals small and narrow; the osseous substance around the labyrinth very hard and compact.	....	do.
....	The same on the left side.	On the left side, the stirrup wanting, the fenestra ovalis closed by an osseous plate attached to its whole circumference.	On the left side, there was the same appearance as on the right.	....	
....	....	On both sides, the external wall wanting, the entire cavity wasted; the ossicles wanting, intimated only by a bony stem.	The semicircular canals and vestibule wasted; the fenestra rotunda closed by coalition; cochlea making only one turn and a half, otherwise normal.	Thinner than normal.	do.

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[*] "Klinik der Ohrenkrankheiten," pp. 341–348. Wien, 1866.

the pupil, but he does not make use of this method for any length of time, and it is abandoned as soon as it can be superseded by speech.

"The daily observations which I have made for more than thirty years that I have devoted to the deaf and dumb, have convinced me that *the art of seeing speech in the movements of the mouth is the most important* of all the branches of instruction, and that therefore it should be most sedulously cultivated.

"Next to the art of seeing or understanding, the act of speaking is the principal object of the instruction of the deaf and dumb. By this system ninety-nine out of every hundred deaf mutes may be taught, and their progress will depend entirely on the talent and patience of the teacher; this truth, too long and often too coldly doubted, is now penetrating everywhere.

"This school was one of the few where I was unfortunate in calling at the season of vacation. I was not, therefore, able to satisfy myself by personal examination as to what extent the attainments of his pupils *en masse* would confirm the remarkable claims he makes in the above paragraphs.

"I had, however, an opportunity of examining an individual case in a manner quite novel, and which put the oral and visual abilities of the pupil to what I conceive to be a very severe test.

"Just as I was leaving Mr. Hirsch, after having held a long conversation with him, in which he urged with much earnestness, and even eloquence, the advantages of his system, a young man about twenty-five years of age entered, who was introduced to me as Mr. Edward Polano, the son of a physician, and who with his sister constituted the first class taught by Mr. Hirsch in Rotterdam. I was told that these persons were born totally deaf, and that they have never at any time gained the slightest power of hearing.

"Mr. Hirsch in introducing Polano to me used the German language, and in telling him who I was used the Dutch.

"As I shook hands with the young man I said, looking him full in the face, 'Sprechen Sie Deutsch?' His answer was promptly, 'Ja wohl.' Immediately I added, 'Parlez-vous Français?' and his answer was as immediate, 'Un peu.' Without a moment's pause I added, 'Sprechen Sie Englisch?'

NAL L.	MEMBRANE OF THE TYMPANUM.	CAVITY OF THE TYMPANUM.	LABYRINTH.	NERVE.	NAME OF OBSERVER.
...	....	Horizontal position of both the malleus and incus; anchylosis of the ossicles.	....	Atrophy of the auditory nerve on both sides.	Voltolini.
...	....	....	....	Atrophy of the auditory nerves.	do.
...	Completely destroyed.	All the ossicles present; stapes immovable; osseous tube carious.	On both sides, superior and posterior canals partly closed by bony material; aditus ad cochleam narrowed; the membranous labyrinth thickened by pseudo-membrane, and unrecognizable; cochlea thickened, and of a gray color, from the presence of pigment.	Atrophy of the auditory nerve on both sides.	do.
...	....	....	....	do.	do.

of the name Pays Bas in Rotterdam. He said he thought not; and so we kept on.

"Growing quite certain we were wrong, I stopped and insisted we were not right, and said I feared I should be too late for the Cologne train if we did not reach my hotel soon.

"He seemed much troubled, and asked me if I would prefer to take a carriage. I said I would; and so we hailed a cab-driver, and Polano asked him if there were two Hôtels des Pays Bas in Rotterdam. The cabman replied that there were; and mentioned that one was Adler's. I then remembered that was the name of the proprietor of my hotel, and so we jumped into the cab and told the driver to go to Adler's Hôtel des Pays Bas.

"Polano said as we rattled over the stones, in a voice that I perfectly understood, 'I hope my mistake will not make you too late for your train; I did not know there were two hotels of the same name here.'

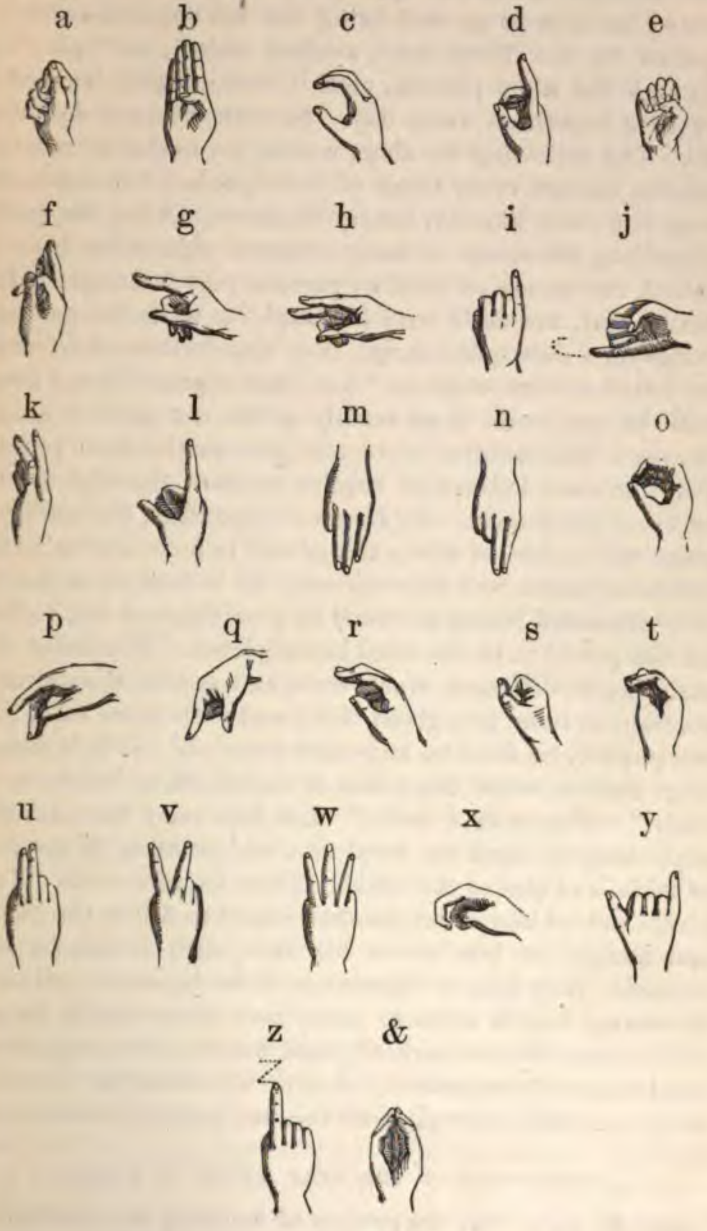
"On reaching my hotel I paid my bill and got my luggage very hurriedly, and then we hastened on in the carriage to the railway station. On the way I took out my watch, and Polano said, 'Is that an American watch?' On my replying in the affirmative he seemed much interested, and wanted to look at it.

"Just before we reached the railroad station, I asked him how much I ought to pay the driver, and he said he thought one florin was quite enough. He asked me when I should come to Rotterdam again, and I said I hoped in a few years. I asked him when I should see him in America. This question I had to repeat a second time, when he replied with a shrug, that it cost too much money; that, perhaps, by-and-by, when he was rich, he would go. I told him he must come to see me in Washington, if he came to America. He replied he certainly would.

"As we reached the railroad station, he said he hoped I would excuse him for making me so much trouble about getting to my hotel.

"As I handed a porter some money for taking my luggage, he remarked, 'You paid him too much.' He accompanied me to the railroad carriage, and bade me good-by, and in a moment the train moved.

DEAF AND DUMB ALPHABET.



the child has learned to spell the word when the hat is presented to it, or to go and bring the hat when the word is spelled to it. Then take another object, as "pin," go through the same process, until it is thoroughly learned by frequent repetition every day. So with *arm*, *cat*, *dog*, *chair*, etc. The following ten short words, the names of common objects, contain every letter of the alphabet, viz., adze, fan, map, cow, box, jar, sky, hat, quill, glove. After the power of spelling the names of many common objects has been acquired, the names of familiar persons may be taught. In a similar way, the child may be taught to write the names of things on a slate quite early. Let him imitate the form of the letters for one word, as "hat," and repeat it many times, until he can write it as readily as he can spell it on the fingers. Take another word and go over the same process. Point to each letter, and require to mark the sign for the letter on the fingers. By frequent repetition, the ability to write the names of many things and to form all the letters of the alphabet will be acquired. It is best to make the child form the letters as round as possibly, and not to take off the pencil until the word is completed. The habit thus early begun will save much time, and enable the writer to accomplish more in a given time, and with more ease, than can possibly be done on any other principle. If it is desired to go further, write the name of the child, as "*John* sees a chair," "*John* sees a table." Let him copy the sentence, explaining by signs the word *sees*, and pointing to the chair or table, and also to the child. Then let him write "John sees," and let him select another object to fill up the blank; and finally, let him cover his slate with sentences thus formed. Help him to objects out of the house as well as in. Encourage him to write as many such sentences as he can. All this may be the work of years, but the advantage to the child cannot be estimated. A little attention thus bestowed every day, will accomplish all this and probably much more.

INSTRUCTION OF THE DEAF MUTES IN SCHOOL.

It is by signs that the process of teaching the deaf mutes is chiefly conducted. When we look at the Chinese characters on a tea-box, we can see no meaning in them, and might so look forever without becoming any wiser. So, also, with the mute. Our written or printed words are as inexplicable to him as the Chinese characters are to us, and inspection alone could never afford any clue to their meaning. An interpreter, or a book, would speedily convey to us the meaning of the characters, through the medium of our language, with which we have been familiar from early infancy. But the deaf mute has no language. To enable him, therefore, to learn the meaning of our words, he must acquire a language through which he can get that meaning. Every mute of tolerable capacity makes use of motions to indicate assent or denial, approbation or repugnance, as well as some common objects and familiar actions. On these motions, limited and imperfect as they are, we graft by degrees a system of signs, which enables us finally to communicate considerable knowledge on many subjects, and to develop and call into exercise the faculties of the mind. These signs convey thought, and have no resemblance to words, but they enable us to define words, explain their relations to other words, give their arrangement in sentences, and the different meanings which are attached to them. This language of signs can only be acquired from the living teacher. Incomprehensible as it may seem to a speaking person, unacquainted with the subject, that thought, however abstruse or refined, may be conveyed by various motions of the arms, it is nevertheless true, and a system of these motions is the grand means of instructing the deaf and dumb. This being premised, a class of ten or twenty mutes is furnished with large slates, on which to write with chalk, crayon, or pencil. The instructor presents an object, or a picture of one, or makes a sign for it. He then teaches them to write the name, presenting each letter by the manual alphabet. When they can all write it, it is erased, and rewritten a number of times, till it is impressed upon the memory. Some information may be communicated respecting the object. Questions may be asked to induce the pupil to think. In this way a number of nouns are taught, so that when a concise sign is made for one of them, it will be readily written.

In the same way words expressive of the qualities and properties of bodies may be taught. When such words are presented with appropriate nouns, the pupils write them in connection. They are then required to give examples of similar combinations from their own resources. This is the first attempt at composition. Another step will be to make signs for actions, and teaching their names. Then the use of these words, in combination with the words already familiar, as "a boy sees a horse," "a boy sees a strong horse."

Again, some of the words expressive of the relations of objects may be taught; as, "a lady sits on a chair," "a bird flies into a cage."

Other words and other ideas are presented to them. They endeavor to express the ideas in writing, using the words and forms of arrangement which had been taught. These sentences are corrected, and the pupils are required to give examples of their own. These original efforts are also corrected. The connections of language, the abstract terms, the phrases and the idioms are successively taught. Series of sentences, anecdotes, narratives, etc. are written off and explained by signs. These are copied by the pupils and studied as evening lessons, and in school are written from memory, or recited by signs.

There are other evening exercises, such as writing a number of original sentences, or single words, composition on particular subjects, letters, etc. From time to time the elementary principles of arithmetic and geography are taught. Indeed, our illustrations of words and principles are drawn from the sciences and the whole range of human knowledge, so that in the course of their education a great amount of knowledge is communicated to them. The subjects of arithmetic, geography, grammar, history, etc. cannot be taught systematically until the latter part of their course, when they are supposed to have acquired a considerable command of written language.

Moral and religious subjects have also a large share of attention. Much useful information is communicated by lectures addressed in the language of signs to all when assembled together.

It will readily be inferred from these statements that much will depend upon the capacity of the pupil, his attention, and his diligence. There can be no set course or limited periods for certain studies, which, when completed, make an educated person.

The longer the mute is under instruction, the greater will be his command of language. It will also be perceived that much depends upon the knowledge, ingenuity, and tact of the teachers in the use of signs. The language of signs is the all-important instrument by which the educator is to reach the mind of the mute pupil in his early and his later efforts. By this alone can he lead the pupil to reflect on his own mental operations, feelings, motives, emotions, and passions, and thus learn the thoughts, feelings, etc. of others, and to understand and use the language employed to express ideas on these subjects. When this point is reached, the pupil may relinquish entirely and forever, if he please, the use of signs. A new instrument has been given him by which he may explore the world of books, and communicate with his fellow-men to an unlimited extent.

From this point, self-education may be carried on and continued to the end of life through written language. It should be remarked, however, that a large number of mutes do not reach this point from want of capacity; yet the acquisitions, even of such, are probably as valuable in proportion as those made by the more gifted. The proboscis of the fly is doubtless as important to the little insect as the trunk of the elephant is to that sagacious and majestic animal.

The deaf mute, when the study of language is begun in our institutions, has passed the favorable age for getting words and phrases.* They delay the commencement of the work till the age of ten or twelve, that they may work upon the higher faculties, but only in accordance with nature. This makes the task more difficult, but the results are more satisfactory.

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* Deaf and dumb children are not received where the sign language is taught, until the age of ten years; while in the schools where the articulate method is employed, the pupil is only required to be five years old—that is, before the articulating muscles have become rigid.

to pursue his studies, and to take special care of his voice, and practice lip-reading as well as articulation. All this was very discouraging, and he was not inclined to enter an institution at first, but after some months did so. In the mean time his voice improved by efforts to converse at home. On entering Columbia Institution, Washington, he was very favorably impressed, finding everything so different from his expectation. The text-books used were the same as in other schools. The sign language and dactylology were the means by which questions were asked and answered; also conversation and illustration were set forth. Instruction in lip-reading and articulation occupied a part of the time. He was taken in hand by a faithful and efficient lady teacher, and, notwithstanding his inability to read a sentence spoken orally, in two weeks' time he was able to understand the greater part of what was spoken by the teacher, and a good deal said by those at home. Lip-reading was a great help, and gave him a great advantage."

Conclusions.—1st. When the deaf mute has the power of hearing at all, it should not be neglected, but should be improved as much as possible by means of hearing-trumpets, etc.

2d. Physicians in charge of public institutions should prepare careful, accurate statistics as to the cause and condition of the ears of the deaf mute on entering and leaving the institution, and what results to the hearing have been developed or improved by their efforts at treatment.

3d. It is an important matter that obstetricians and nurses should be carefully taught the anatomy and pathology of the ear, as the deafness of many of the so-called congenital deaf mutes is the result of mucus or blood in their meatus or tympanic cavity at birth. Another cause is physicians not attending in time to the catarrhal deafness, the result of cold from exposure or teething. The nurse is often at fault in placing the ears of infants in draughts of cold air, and allowing cold water to enter the meatus, pass back to the membrane, lodging there and causing acute inflammation, shown by intense pain and persistent earache, not relieved until perforation of the drum-membrane takes place or extension to the internal ear or brain.

way between Forty-fourth and Forty-fifth Streets. I was accompanied by Prof. Elsberg, and we were at once ushered into the school-room. The pupils, as a class, had to me a very intelligent look. The first pupil brought forward was a little girl of nine years of age. The principal caught her eye, and spoke to her in a whisper, without any special contortions of the mouth, and without hesitation the child replied, by writing upon the blackboard, "This gentleman is from Philadelphia, and he is a doctor." He then called upon a boy, who was a congenital mute, who also repeated his words with more effort. I was then requested to test their proficiency, by asking them a question in arithmetic; which I did; and, although I wore a moustache covering my lips, two of them at once comprehended my question, and answered it promptly. Other questions were answered by them, and they could read the lips of the principal (Prof. F. A. Rising) the whole distance of the school-room, some twenty-five or thirty feet. There were also children who were day-scholars; and one very intelligent little fellow delighted us and his parent very much by being able to say "father and mother." He also called out "Home," when it was time to go. There was great diversity in the sounds which they uttered, some being more or less disagreeable; but none of them as harsh as an animal, to which it has been compared. The consonants were the most difficult to pronounce; but the principal showed great ingenuity in his efforts to make them understand them by the vibration on the head and on the neck. He gives the following explanation of the *method:*

"*Explanation of the articulate method.*—At the risk, on the one hand, of being unnecessarily explicit, and on the other, of not clearly and concisely illustrating the mechanical formation of letters, the following attempt to explain some of the sounds of the alphabet is made. It is hoped that the parents of little ones, who are deaf, will thus acquire some hints which will enable them to teach their children to utter, not alone the sounds here described, but all the sounds of the different letters and words easy of pronunciation.

"The foundation of the system rests upon the fact that articulation is simply a *mechanical process*, the result of certain well-defined positions and movements of the vocal organs, together with a more or less forcible expulsion of air from the lungs. Of the former, his sense of vision renders the mute cognizant; of the latter, his sense of feeling.

"All children are imitative,—the mute child is particularly so,—and it is upon the possession of this faculty, *imitation*, that our success in teaching him depends. We proceed, then, at the outset, by making simple gestures with the arms, the easier gymnastics in short; then we walk, look in various directions, sit, stand, etc., all which operations he readily performs.

"Having thus engaged his attention, place him directly in front of you, press your upper teeth in a marked manner upon the lower lip, hold a bit of paper in your hand, and blow; he sees the paper fly away, is amused, imitates the process, and has given his first letter, *f*. Again, swell your lips out with air, open them quickly, the paper flutters away; this is *p*. Should he be too forcible, or not sufficiently so, in forming this letter, then imitate a person smoking a pipe; the *puff*, *puff*, conveys the idea of *p* exactly.

"*T*. Place the tongue between the teeth, force the air out so that it shall come in one volume,—best felt on the back of the pupil's hand,—and *t* is produced.

"*H* is simply the expiration of breath with slightly increased force, the mouth opened naturally.

"*M*. With closed lips the force of the letter *m* is felt by the pupil, who must apply his finger to the side of his nose; the vibration indicates the rapid expulsion of air from the lungs.

"*N*. In the same manner the mute learns the nasal *n*, but is shown the mouth opened slightly and the tongue pressing against the back of the upper teeth.

"These six consonants are the ones perhaps most easily learned.

"*B* is formed like *p*, but is accompanied with sound, the throat is both seen and felt to dilate, and the expulsion of breath is also less forcible, the puff is gentler.

"*D* resembles *t*, although it is better in the beginning to teach the pupil to place the point of the tongue back of the upper teeth; the vocalization is made apparent as in the case of *b*, also the less decided emission of breath.

"*V* is simply a vocalized *f*, and as in the case of *z*, and the sub-vocal *th*, the vibration is most sensibly perceived by pressing the palm of the pupil's hand upon the crown of your head.

"*O*. The vowel *o* is attended with no difficulty. Place the child's hand firmly on your chest that he may feel the vibration, while he sees your mouth assume the shape of the letter produced.

"*E*. Place the pupil's fist under the angle of the jaw, the peculiar and forcible vibration there felt he readily produces.

"*A*. Press the palm of the pupil's hand against the chest, and show him your tongue firmly set against the lower teeth, and somewhat arched; with this position the letter *a*, as in fate, is produced. (The German method is to teach *a* as in far, first, which is accomplished by holding the tongue down with the finger, or better, by a paper divider; this is, however, entirely unnecessary in teaching the English language.)

"*I*. To form *i*, open the mouth very wide, and, as you produce sound, close it quickly.

"*U* is made like *o*, except that the lips are nearly closed.

"As soon as the pupil has learned the sounds of the vowels, require him to join a consonant with each in succession, making easy syllables, as *fa*, *fe*, *fi*, *fo*, *fu*, and reversing the letters, *af*, *ef*, etc. Next teach him simple words, the names of objects, which he can see, or pictures of them which can be shown him, as *map*, *mat*, *cat*, *top*, etc. The next step is to embody these in the form of a sentence, as 'What is that?' 'That is a top.' 'What is that?' 'That is a cat.' 'What are those?' 'Those are maps.' The point cannot be too strongly insisted upon that the child should write as well as speak everything he learns. This constant practice strengthens the memory, and insures steady and permanent progress."

I am satisfied that this system must improve and develop r lungs and chest. This system is not a recent experient, except in a few institutions, but has been in active tution it was demonstrated to his satisfaction that oral conversation on familiar subjects is maintained with ease between the teachers and a large proportion of the pupils.

"The following extract from a sketch of the institution, prepared by M. Deutsch, the director, will show what is attempted in the course of instruction:

"'In this institution the manual alphabet or finger language, artificial mimicry,* and conversation by pantomime have been entirely excluded. The natural gesture is only used as a starting-point, as the first medium of understanding, which in the instruction only serves to represent real ideas obtained by personal observation through actual perception, but not to produce ideas or notions by means of signs. The method prevailing in this institution tends to make oral language and written language independent of the pantomime,—that is to say, the direct channel and medium of thought. The written language is assumed as the basis of instruction. It begins with a single word which conveys a subject, action, or quality, and leads the pupil to a connected idea. The *copia verborum* obtained in this manner is used through a regular course of exercises to form a simple sentence, and continued up to the explanation of the abstract idea. The understanding of the abstract idea is obtained in a natural way, by plain and combined sentences as well as through short descriptions and narratives. This is very different from the true elementary method made use of with other intelligent children. The instruction of religion commences only then, when the pupil has advanced so far as to understand the plain expressions of thought. Thus his religious education undergoes no especial difficulty, as the reading of the Holy Scriptures is already begun. Upon oral language a decided value is placed, and therein important results are obtained.

"'The pupil not born deaf enjoys the particular advantage of acquiring the verbal language with greater facility. Read-that he met you, and that you were well and improving in yǒur studies.' With regard to this boy, I should venture the opinion that he read from the lips (so far as his range of study had extended) with as great readiness as any pupil of his age and standing in the institution. The President of the Northampton school visited, in 1870, M. Deutsch, who for twenty-five years has had this school under his charge, and found him with all the enthusiasm of his youth, and aided by a corps of excellent teachers, with a class of about one hundred pupils.

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* This is understood to refer to the exercises of the school-room. Among the pupils, during their hours of relaxation, the sign language and manual alphabet are freely used in conversation.

E. M. G.

THE INSTITUTION AT ROTTERDAM, HOLLAND.

"An address on the subject of deaf-mute instruction, delivered before the 'ninth congress (scientific) of the Netherlands,' in Ghent, last August, by Mr. Hirsch, the director of the Rotterdam school, so clearly defines his position as a radical supporter of the artificial method that I* will quote a few paragraphs from it before proceeding to describe my visit to him and his establishment:

"The first and principal fact that has been made patent to society is the possibility of developing intellectually, morally, and religiously the deaf and dumb. As to the means by the aid of which instruction can and ought to be imparted to them, opinions are very diverse, often very contradictory. Those diversities and contradictions of opinion have given rise to differences in methods of instruction, and to dissensions between the schools of France and of Germany.

"The object to be attained is to render possible the admission of the deaf mute into society by teaching him to see—that is, to understand—the movements of the lips and to speak in his turn.

"To attain this end the act of seeing or comprehending and of speaking must be the exclusive principle of instruc[illegible] and neither the palpable alphabet nor the language of [illegible] have any connection with it.

[illegible] true that the language of natural signs is the first [illegible]mployed by the teacher to enter into relations with

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* Report of Edward M. Gallaudet, M.A.

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of the name Pays Bas in Rotterdam. He said he thought not; and so we kept on.

"Growing quite certain we were wrong, I stopped and insisted we were not right, and said I feared I should be too late for the Cologne train if we did not reach my hotel soon.

"He seemed much troubled, and asked me if I would prefer to take a carriage. I said I would; and so we hailed a cab-driver, and Polano asked him if there were two Hôtels des Pays Bas in Rotterdam. The cabman replied that there were; and mentioned that one was Adler's. I then remembered that was the name of the proprietor of my hotel, and so we jumped into the cab and told the driver to go to Adler's Hôtel des Pays Bas.

"Polano said as we rattled over the stones, in a voice that I perfectly understood, 'I hope my mistake will not make you too late for your train; I did not know there were two hotels of the same name here.'

"On reaching my hotel I paid my bill and got my luggage very hurriedly, and then we hastened on in the carriage to the railway station. On the way I took out my watch, and Polano said, 'Is that an American watch?' On my replying in the affirmative he seemed much interested, and wanted only in a few instances deaf mutes. When one or both parents could hear the human voice as sounds, but were unable to distinguish words, the whole number of children born were hearing children. In those who could distinguish loud noises, such as clapping of hands, the ringing of bells, thunder, cannon-firing, etc., a part of the children were born deaf.

To remedy the evil of deaf mutes marrying, Prof. Bell advocates the separating them as much as possible from each other during the time he or she is being educated. They should not be sent to asylums; they should be taught English instead of the sign language. Of two thousand one hundred and six pupils in the Deaf Mute Asylum at Hartford, thirty-three per cent. had relatives afflicted in the same way. The statistics of the Pennsylvania Institution for the Deaf and Dumb, which have been carefully collected and collated by the special committee of investigation, covering a period of ten years, hardly bear out Mr. Bell's theory. Three hundred and forty families have in this period sent children to this institution. In the case of six only of these families the parents are deaf, in five of the six congenitally deaf, and the total number of deaf children sent by deaf parents is ten; of these four were born deaf, and the other six became deaf by accident or disease. The same parents had twelve hearing children. In the case of the graduates of the institution, forty of them—twenty couples—have married since leaving the institution, sixteen of whom are known to have been congenitally deaf. To these twenty couples of deaf mutes there have been born, so far, just twenty children, of whom but two were born deaf.

Of the three hundred and sixty-four graduates of the Pennsylvania Institution, whose record is given in detail [illegible] their report, one hundred and thirty-two were born deaf, [illegible] two lost their hearing from some [illegible] these one hundred and fifty-four [illegible] some form of fever. The large[illegible] from disease is accounted for by [illegible]rly all the children of poverty, [illegible] the inability to secure timely [illegible]

Dr. R. Mathison, Superintendent of the Ontario Institution for the Deaf and Dumb at Belleville, writes: "As far as Ontario is concerned, Mr. Bell is very much astray in his theoretical conclusions." In this institution there are the histories of six hundred and sixty-one mute children, who are now or have been pupils since its establishment. He has acquaintance with the parents of about three hundred of the children, and has made inquiries during the last five years of many of the others. Up to this time he has been unable to find that any of the parents were or are deaf and dumb.· A few of the grand-parents, however, were mutes. A considerable number of deaf and dumb persons in the province are intermarried and have children, and in every case that has come to his knowledge the children can hear and speak. He further says, "That as the instances of hereditary deafness are so few in proportion to the number of deaf and dumb persons, and form such a small fraction of the population, an evolution of a distinct race of mutes need never be feared. Of the six hundred and sixty-one cases above noted two hundred and sixty-two were born deaf; the others lost their hearing by fevers, measles, colds, etc."

A rough calculation of the number of deaf mutes in the world is given in the *London Echo* to be from seven hundred thousand to nine hundred thousand, and of these eighty-three per cent. are said to be born deaf, the others losing their hearing by different accidents. The number of deaf mutes in Great Britain is about twenty thousand. To meet the educational wants of these there are on the face of the globe three hundred and ninety-seven institutions, containing twenty-six thousand four hundred and seventy-three inmates of both sexes, and employing over two thousand teachers.

Excepting those who are immediately interested in and connected with the education of the deaf mute, there are few [illegible] appreciate the great amount of care, attention, skill [illegible] necessary that even the simplest principles of [illegible]ual education may be inculcated.

[illegible]ry that muteness does not always imply dumbness [illegible]ise to much discussion as to the proper method of [illegible]eaf mutes, and of the two systems now employed leading writers on the subject are divided in opinion as to which is the better one.

Advancing science has taught that the organs of speech in a mute person can be improved to some extent if the muteness is the result of deafness and not of the absence of the organs of speech. In the latter instance the system of educating by articulation could not be of any avail; but all those who have the organs of speech should be taught, as far as possible, by articulation, and a thorough examination should be made of every pupil to ascertain this fact. Many of the most prominent institutions for the education of the deaf mute employ both methods, and the Pennsylvania Institution, of Pennsylvania, one of the oldest and best-managed schools of the kind in this country, has adopted both methods; and in the branch school at the corner of Clinton and Eleventh Streets, Philadelphia, under the management of the directors of the Pennsylvania Institution, the education of the deaf mute in this department is by articulation only. It is attended now (1885) by seventy pupils, being recently changed from a day-school to a boarding school for the benefit of those living outside of the city. The principal, Miss Emma T. Ely, has nine assistants, and the school is managed with great success. Of deaf mutes now in the school many are far advanced, and compare in some branches very favorably with other children of the same age where the acquirement of knowledge has not been hindered by the loss of speech or hearing and who have had the double advantage of both eyes and ears.

The sign language, further than the simple letters of the alphabet, is not taught in the Pennsylvania Institution: and the system, which consists in the formation of ideas by illustrations and observation, which the pupil is taught to write, has been adopted and is very successful in its results. It is as interesting as the system of articulation, and also requires the same diligence and patience on the part of the teachers. When the pupil is sufficiently advanced in the knowledge of words and their meanings, he is then taught to read and study such branches as geography, physiology, history, and composition. In teaching by lip-reading, or articulation, the pupil must learn to speak the word before he learns to write it. The pupils that have at one time had the power of speech advance rapidly, but the child that is born deaf not only has no knowledge of his power in this respect, but does not know what spoken words are when he utters them; but, in spite of all these difficulties, is made, in time, to talk, and sometimes surprisingly well.

The introduction of the improved methods and important changes which have recently been made by the Pennsylvania Institution, have attained highly satisfactory results. When we visited the school and were shown through the various departments by the principal, Prof. A. L. E. Crouter, a very proficient teacher, who, by long and careful study of the best-known methods, has become well fitted to fill the place of our friend Professor Foster, we found but one difference between it and other places of learning: this was the lack of covert whispering behind slates and around the corners of desks; the pupils were for the most part diligently at work, and the best order prevailed.

The following is an account of a deaf mute's* experience, given by himself, whom we had the opportunity of knowing, and who was examined by myself and my son, Dr. C. S. Turnbull:

"At the age of fifteen years he enjoyed apparently good health, but was suddenly transformed into a deaf mute by *cerebro-spinal meningitis*, the result of a cold taken at a circus on a cold, rainy night. After remaining in an unconscious state for two weeks, he found his hearing and speech were both gone. On gaining strength, his voice partially returned, but his deafness was total. The usual remedies were applied, but without any apparent benefit. His friends all came to his rescue with catalogues, circulars, 'phones,' ear-drums and ear-trumpets, etc., and cures of every description; but a scientific treatment was deemed the best.

"He accordingly came to a Philadelphia aurist. All treatment proved of no avail, and, after trying all kinds of instruments, he was advised to enter an institution for deaf mutes

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* Robt. Bell, Jr., 3d, Alexandria, Va.

4th. Then, again, hereditary tendency to disease of the ear in tuberculosis and so-called rachitic, scrofulous, or syphilitic children should be watched from infancy to puberty, so that every acute catarrhal attack commencing at the nose and extending through the Eustachian tube to the middle ear, producing deafness, should be carefully treated by the relief of pain, cleansing by a mild antiseptic solution or powder, followed by constitutional remedies adapted to the peculiar constitution of the child. By these means we shall still further reduce the number of the so-called congenitally deaf mutes. I have found a most valuable aid for the relief of the deafness of little children after the acute attack, in the use by the mother of a tube to inflate the Eustachian tube, also to teach the child as early as possible to blow its nose, as by this latter means we often get rid of the mucus in the Eustachian tube and pathway to the ear. The throat must also be attended to by applications to the naso-pharyngeal mucous membrane.

5th. The only true plan to come to a definite conclusion as to the deaf mutism being acquired or congenital, is to examine the outer and middle ear, Eustachian tube, and the sound-conducting apparatus with the throat, eyes, and nose.

THE INFLATION OF THE EUSTACHIAN TUBE IN AURAL CATARRH OF YOUNG CHILDREN.

The mode of the use of a tube to inflate the Eustachian tube by the mother.—The physician must be sure that the cause of deafness is an exudation of pus, mucus, or serum into the middle ear. If the child has had an earache, and there has been a perforation of the membrana tympani shown by a discharge, in this case the simple act of blowing the nose will open the tube; this act should always be taught the child.

If the child is too young to perform this, the nose must be cleansed several times a day with a soft camel's-hair brush, or small syringe and warm water, with a few grains of bicarbonate of soda, that will assist in opening the tube. If, however, there has been inflammation of the middle ear of the child, the result of a cold from a naso-pharyngeal catarrh, acute exanthema, or pneumonia, attended with pain in the ear, or, if the acute symptoms have been relieved by leech-upper teeth; the vocalization is made apparent as in the case of *b*, also the less decided emission of breath.

"*V* is simply a vocalized *f*, and as in the case of *z*, and the sub-vocal *th*, the vibration is most sensibly perceived by pressing the palm of the pupil's hand upon the crown of your head.

"*O*. The vowel *o* is attended with no difficulty. Place the child's hand firmly on your chest that he may feel the vibration, while he sees your mouth assume the shape of the letter produced.

"*E*. Place the pupil's fist under the angle of the jaw, the peculiar and forcible vibration there felt he readily produces.

"*A*. Press the palm of the pupil's hand against the chest, and show him your tongue firmly set against the lower teeth, and somewhat arched; with this position the letter *a*, as in fate, is produced. (The German method is to teach *a* as in far, first, which is accomplished by holding the tongue down with the finger, or better, by a paper divider; this is, however, entirely unnecessary in teaching the English language.)

"*I*. To form *i*, open the mouth very wide, and, as you produce sound, close it quickly.

"*U* is made like *o*, except that the lips are nearly closed.

"As soon as the pupil has learned the sounds of the vowels, require him to join a consonant with each in succession, making easy syllables, as *fa*, *fe*, *fi*, *fo*, *fu*, and reversing the letters, *af*, *ef*, etc. Next teach him simple words, the names of objects, which he can see, or pictures of them which can be shown him, as *map*, *mat*, *cat*, *top*, etc. The next step is to embody these in the form of a sentence, as 'What is that?' 'That is a top.' 'What is that?' 'That is a cat.' 'What are those?' 'Those are maps.' The point cannot be too strongly insisted upon that the child should write as well as speak everything he learns. This constant practice strengthens the memory, and insures steady and permanent progress."

I am satisfied that this system must improve and develop their lungs and chest. This system is not a recent experiment, except in a few institutions, but has been in active operation in Germany from 1760 to the present time, and I trust ere long will be introduced throughout this country. This method has lately been introduced, in part, into the Pennsylvania Deaf and Dumb Institute at Philadelphia, and has been in operation at Northampton, Mass., and in New York, since 1867. Last winter (1870) this latter was placed upon the same footing as the old New York Asylum by the State Legislature, which is highly creditable to its intelligence, and to its care for the indigent mute, who can now be taught what was only to be obtained by the rich at great expense, time, and trouble.

Let me, in this connection, give a few more extracts from the report of the principal of the Columbia Institution, who recently made a visit to Europe to examine into the whole subject; and who is not in favor of the artificial method, yet he endeavors to give a fair statement of what he saw of this mode of instruction:

"The institution at St. Hippolyte du Fort, France. Here the manual alphabet is unknown by the pupils; articulation is taught to all. The director is M. Martin, whose wife is also a teacher. They admitted that schools conducted on the natural method had done a good work, and were even willing to admit that as a means of affording instruction this method is superior to the artificial. They held to the view, however, that the power of communicating freely in speech with their fellow-men, which was acquired by mutes under the latter system, was so great a boon as to justify a lower standard in the intellectual training of the deaf and dumb. Prof. Gallaudet states that he conversed orally with the pupils, and with the best articulators had little difficulty in making himself understood. The utterances of some were unintelligible, but those of others very distinct; and he remembers that one in particular, who was said to have been born deaf, spoke well, and read from his lips with ease.

"The Jewish institution at Vienna, Austria, is sustained entirely by private contributions within their own circle, and open only to their children. This school is conducted on the most rigid principles of the artificial method. Articulation is undertaken with all the pupils, and on his visit to the institution it was demonstrated to his satisfaction that oral conversation on familiar subjects is maintained with ease between the teachers and a large proportion of the pupils.

"The following extract from a sketch of the institution, prepared by M. Deutsch, the director, will show what is attempted in the course of instruction:

"'In this institution the manual alphabet or finger language, artificial mimicry,* and conversation by pantomime have been entirely excluded. The natural gesture is only used as a starting-point, as the first medium of understanding, which in the instruction only serves to represent real ideas obtained by personal observation through actual perception, but not to produce ideas or notions by means of signs. The method prevailing in this institution tends to make oral language and written language independent of the pantomime,—that is to say, the direct channel and medium of thought. The written language is assumed as the basis of instruction. It begins with a single word which conveys a subject, action, or quality, and leads the pupil to a connected idea. The *copia verborum* obtained in this manner is used through a regular course of exercises to form a simple sentence, and continued up to the explanation of the abstract idea. The understanding of the abstract idea is obtained in a natural way, by plain and combined sentences as well as through short descriptions and narratives. This is very different from the true elementary method made use of with other intelligent children. The instruction of religion commences only then, when the pupil has advanced so far as to understand the plain expressions of thought. Thus his religious education undergoes no especial difficulty, as the reading of the Holy Scriptures is already begun. Upon oral language a decided value is placed, and therein important results are obtained.

"'The pupil not born deaf enjoys the particular advantage of acquiring the verbal language with greater facility. Read-was not long before she would say 'up-stairs' to us many times in the day, meaning to ask us if she could go up.

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* This is understood to refer to the exercises of the school-room. Among the pupils, during their hours of relaxation, the sign language and manual alphabet are freely used in conversation.

E. M. G.

"In this way we did what we could for her until we took her to school. The manner in which we had begun with her was very kindly commended, and we were advised to continue talking with her and teaching her words, which we have done. None of her questions—and they are very numerous—are ever allowed to go unanswered. We always encourage her to talk to us about her play and everything that interests her, and try to explain what she does not understand. But our feeble efforts seem like nothing in comparison with what her teacher has done and is still doing for her. We appreciate it all, and only hope that Bertha may long remain under her skillful guidance and care."

No one should be allowed to make motions or signs to the child, or to teach it the manual alphabet as it grows older. It should be strictly trained to depend on lip-reading and that alone. When the child is old enough, it may be taught to write words and sentences as soon as it can articulate them and read them from the lips, but not before.

There are no doubt mothers who would be skillful enough in training their children from the beginning so that they would never need to go to special schools for the deaf, but could be taught with the hearing; probably, however, the majority of parents would need to send their children to schools taught by specially-trained articulation teachers, for awhile at least. Such teachers should be equally strict that all communications with their pupils, in classes and out of classes, at the table, on the play-ground, and on all occasions, should be through speech and speech alone. It is the universal experience that hearing children who study French and German in English schools, where all their lessons, outside of these special classes, are recited in English, do not learn to speak these languages. If deaf children are given special lessons in articulation in schools where they see signs and the manual alphabet used constantly around them, and where they use them in the play-ground, at the table, or in their classes, the cases where they become proficient in the actual use of speech and lip-reading will be as rare as of those hearing children who become proficient in French and German under similar circumstances.

Children or grown persons who lose their hearing through sickness, should at once be trained to read the lips and encouraged to talk just as they did before, and they should as studiously be kept from all contact with signs or manual alphabet as the congenitally deaf.

Miss Emma Garrett, Principal of the Pennsylvania Oral School for the Deaf, at Scranton, Pa., describes, in the January number of the *Annals of the Deaf* for 1886, the case of a pupil of hers. He was a young lad, who lost his hearing in May, 1885. Under her direction he was induced to continue to talk as before and to depend on lip-reading alone for his communication with others. After spending a very few weeks under her instruction in the autumn, he was able to take his place in the hearing-school which he had formerly attended, and all his communication there is through speech and lip-reading. There is a great difference in the aptitude of this class of the deaf for acquiring lip-reading; some seem to be what might be called natural lip-readers, and learn it from their associates simply by watching their lips, while others need training from special teachers. All such persons should, however, train themselves or be trained to depend on lip-reading and speech, and not on writing.

It needs very little reflection on the part of intelligent minds to estimate the difference in the life of a person who is able to understand the speech of those around him, and to make himself understood by them, from the life of one who knows only signs and the manual alphabet, which are almost unknown outside of the institutions where they are taught.

As there is only one deaf person to every fifteen hundred hearing persons in our population, it behooves us to help that one deaf person to fit himself for communication with those fifteen hundred. We cannot expect the fifteen hundred to learn manual alphabets or arbitrary signs to suit the one deaf person.

There is a popular delusion that the vocal organs of deaf children are defective; the fact is that such cases are rare exceptions, and that as a rule their vocal organs are normal. The articulation of consonant sounds depends on certain positions of the lips, tongue, teeth, and palate. The quality of vowel sounds depends on certain positions of the tongue. Any deaf child who can cry and scream, and has lips, tongue, teeth, and palate, has the necessary vocal organs.

The deaf children are capable of being taught by the *Pure Oral Method*, and the method is a success when parents, caretakers, and teachers know how to apply it. It is possible for deaf-born children to learn speech and lip-reading after they begin to go to school, if they have competent teachers; but much time would be saved and far better results obtained if parents would do their part before the child is sent to school.

Great results have already been gained through the Oral Method, and I have no doubt that greater and better results than any already obtained await us in the future, as the method becomes more widely and more strictly and intelligently applied. The oral pupil who has the least amount of intelligible speech and of lip-reading, compared with his fellow oral pupils, has just that much advantage over the most expert maker of arbitrary signs and the manual alphabet, which are sure to be as unintelligible to the general public as our speech is to the sign-maker.

The more perfect we can make the speech of the deaf, and the more skillful we can train them to be in lip-reading, and the greater the amount of language we can teach them, the happier and more independent they will be.

CHAPTER XX.

CAUSES OF EAR DISEASES.

RÉSUMÉ OF THE CAUSES AND MOST SUCCESSFUL TREATMENT OF THE MORE FREQUENT DISEASES OF THE EAR.

LET us not forget the importance of the study of some of the causes of ear diseases.

First, Heredity. *Second*, Malaria. *Third*, Functional. *Fourth*, Traumatic. *Fifth*, Meddlesome Interference.

Hereditary predisposition to ear diseases is found in certain families. In looking over our records we find it can be traced without difficulty to great-grandparents, grandparents, and from mother or father. Sometimes as many as four brothers in one family; in another, three sisters; and in certain families for several generations there are one or two who are deaf, and this occurring at a certain age.

The most common form in which this deafness shows itself is an inflammation of the middle ear (or chronic middle-ear catarrh). Another very common form is disease of the Eustachian tube from coryza attacking the nose, passing along the throat to the orifice of this tube. Certain persons are very susceptible to cold from a draught of air on the back of the neck, side of the face, or from dampness and exposure of the skin when overheated, and, above all, from cold or dampness brought in direct contact with the feet or limbs.

This catarrh of the Eustachian tube, as we have shown in another place, is very common even in infancy, half-grown children, and in the growing youth of both sexes. It is aggravated by every cold in the head; this is owing to the small, fissure-like shape of the pharyngeal orifice of the tube; the mucous membrane swells, and closes this tube, and then the pressure of the outer air on the closed drum membrane drives it inward and prevents acute hearing.

In old persons we find just the contrary condition. There is so much relaxation in want of power over the muscles around the tube, that they are unable to act, and cannot draw away the membranous walls of the tube so as to open and shut it with regularity.

In a certain class of females this hereditary tendency to disease of the ear is seen, and it is generally accompanied by some other affection, such as anæmia, dyspepsia, and in convalescents from diseases such as pneumonia, Bright's disease of the kidneys, lithuria, and diabetes.

In another class hereditary deafness is chiefly the result of a general debility or marasmus. They have a sclerosed throat, with thickened and elevated patches, with hypertrophies about the orifices of the Eustachian tubes, have almost always a very dry and delicate skin and an impressible and irritable nervous system.

ON THE DIAGNOSIS AND TREATMENT OF EAR DISEASES.

Take a general glance at the ear and side of the face: note the history, past and present, and describe any abnormities in the form of the external ear, auditory canal, Eustachian tube, and membrana tympani.

Subjective symptoms.—Deafness, pain, tinnitus aurium, discharges.

What are the instruments which are absolutely necessary to diagnose cases of ear disease, as well as to treat the same?

An aural mirror, with head-band and handle.
A set of aural specula or one modified form.
A Siegle's pneumatic speculum.
A Politzer's air-bag and flexible attachment.
An otoscope or auscultating tube.
A diapason (or tuning-fork).
A watch. (A "stop-watch" to be preferred.)
A set of Eustachian catheters.
A half-pint ear-syringe, with extra points.
Three rhinoscopic mirrors.
A good student-lamp, or an argand gas-burner, or electric lamp.

Having by a general examination of the external ear, mastoid region, face and neck, found nothing abnormal, you test the *hearing distance* of the patient. This is done in several ways, but two will be at present sufficient, the "tick tack" of the watch, and the human voice. Determine beforehand the average hearing for your watch, by testing in several young persons whose hearing is considered perfect. In testing the hearing distance with the watch, cause the patient to close the other ear with his finger. The surgeon stands in front of the patient with the watch in hand. At first hold it at arm's length from the ear to be examined, and, if not heard at that distance, gradually approach to the ear of the patient until its "tick tack" is distinctly heard. (If children are to be examined, they must close their eyes when testing the tick of the watch.)

Next, the other ear is examined with the same care. You then examine the patient in regard to hearing the tones of articulate speech, as the whisper, ordinary voice, tones in conversation, and loud voice: even shouting into the ear. The deaf mute is examined with a bell, and the sounds of concussion when two books are forcibly brought together.

This is to be expressed in a uniform method, as suggested by Dr. Knapp, as follows (Trans. Amer. Otol. Society, 1885):

He adopts a watch of 24″ hearing distance on application to the meatus, the temple, the forehead, etc.

$$h = \frac{24}{24''} = \text{normal audition for the watch.}$$

$$h = \frac{24}{24} = \text{ordinary voice, and highest tones of the voice.}$$

$$v = \frac{20}{20'} = \text{n. h. for whispered voice.}$$

$$v = \frac{60}{60'} = \text{n. h. for conversational speech.}$$

$$\left.\begin{array}{l} v = \dfrac{20'}{\propto} \\ v = \dfrac{60'}{\propto} \end{array}\right\} \begin{array}{l} \text{whisper or speech heard, but not understood;} \\ \quad \textit{i.e.}\text{, quantitive perception of sound.} \end{array}$$

$v\ 60' = 0 =$ voice not heard at all. H-Aud. (auditus) $= 0$, complete deafness for all sounds.

$h = \frac{\text{c}}{24''} =$ a watch of 24″ hearing distance is heard when applied to (on contact with) the ear.

$h = \frac{\text{pr}}{24''} =$ a watch of 24″ h. distance heard when pressed on the ear.

$h = \frac{\text{m}}{24''} =$ watch of 24″ h. distance heard when applied to the mastoid.

$h = \frac{\text{I}}{24''} =$ watch of 24″ h. distance heard when applied to the temple.

$h = \frac{\text{d}}{24''} =$ watch of 24″ h. distance heard when applied to the teeth.

$h = \frac{\text{gi}}{24''} =$ watch of 24″ h. distance heard when applied to the forehead (glabella).

$h = \frac{\text{v}}{24''} =$ watch of 24″ h. distance heard when applied to the vertex.

$h = \frac{\text{ub}}{24''} =$ watch of 24″ h. distance heard when applied everywhere (ubique).

These symbols would also signify that bone conduction for the watch is preserved in the places indicated.

One thing only is to be added, and that is, when the watch is not heard from the places indicated in these abbreviations. In this case we would write them as follows:

$h = \frac{\text{e}}{24''} = 0.$

$h = \frac{\text{m}}{24''} = 0$, etc., which means that a watch of 24″ hearing distance is not heard when in contact with the ear, not when applied to the mastoid, etc.

$h = \frac{\text{ub}}{24''} = 0$, means that the watch is heard from no part of the head. In other words, that bone conduction for the watch is lost. This is the simplest mode of expressing by short symbols what we have constantly to enter in our case-book, what we have to write to each other, what we have to print. Dr. J. Orne Green, of Boston, always wants recorded in which ear the tuning-fork is heard the loudest. He therefore has three forks, the middle C, the next C, and the highest A. He indicates the ear, as we all do, by the letters R and L.

We also test the air conduction in air and over the temporal bone at the same time, to determine if it is labyrinthine deafness, or middle ear. If the tone is loudest on the temple, or, by bone conduction, as a general rule, we locate the disease in the Eustachian tube and middle ear. If there is profound deafness, and the sound is heard loudest in the meatus, we consider it internal-ear deafness. This rule, like all rules, has its exceptions.

Twelve years ago, or more, Cassells, of Glasgow, published a case in which, after exfoliation of the left cochlea, the hearing power actually improved, and all the notes of the piano were perceived. More lately Schwartze and Christenneck had under their care a patient who, in spite of the loss of the right cochlea, continued to hear the tuning-fork (C) by bone conduction louder in the affected ear. Jacobson, too, has recorded a case in which, notwithstanding suppurative disorganization of the cochlea, hearing by bone conduction was retained until just before death. The last contribution towards this subject is by Gruber, who records an instance of exfoliation of the two upper convolutions of the cochlea, associated with only partial loss of hearing on the affected side, and retained bone conduction. Schwartze, in his recently-published work, accepts frankly the position which alone is tenable,—assuming, as we have every reason to assume, that these observations are accurate. According to this author, retained bone conduction only proves the trunk of the auditory nerve and its centre to be sound, but does not necessarily imply a healthy condition of the labyrinth. But, even with this condition before them, there may probably be found those (Dr. McBride) who, on the ground that such facts are contrary to physiological common sense, will refuse them the consideration they deserve in clinical investigation.

On minute diagnosis and various use of instruments in examination of the auditory canal and membrana tympani, throat, pharynx, and Eustachian tubes and their orifices, termed Rhinoscopy. For a more full account of its application to diagnosis, see pp. 252–65.

The next subject in order is remedies which we have found useful in the treatment of diseases of the ear.

AURAL THERAPEUTICS.

In every affection of the ear, of definite duration, search should be made for the diathesis as a cause,—*i.e.*, scrofula, gout, rheumatism, herpetism, and syphilis. The treatment applied for these latter is of wonderful efficacy, notably the mineral waters, sea and river bathing; cold water and sea baths aggravate catarrhal and labyrinthine affections, but benefit most other diseases of the ear, of a chronic nature. (See our short paper, the first on this subject published in this country. 1876.*)

Diseases of the petrous portion of the temporal bone, and of the mastoid process, will be benefited, and in some instances cured, by the prolonged use of the sea bath, also certain forms of nasal catarrhs, especially those in children. The strong sulphurous springs are to be especially recommended for scrofulous or syphilitic otorrhœas, when there is diseased bone. Several cases are reported, by Hartmann, in which the waters of Barèges were of wonderful efficacy. If the bone is not affected, the milder sulphurous waters may suffice. The arsenical waters of Bourboule, and others, are serviceable in scrofulous affections where the mucous membrane and lymphatic glands are involved. The alkaline springs have been very efficacious in the author's experience for the middle-ear affections dependent upon the gouty diathesis. It is well known that sulphurous waters have a wonderful power over the system, and, when they are applied with discrimination and care, are of great value. Our country is fortunately well supplied with mineral waters which are impregnated with sulphuretted hydrogen, known as "sulphur water," such as those of the Yellowstone region, Arkansas, Richfield, Sharon, and Avon, also the White, Red, Warm, and Hot Sulphur Springs of Virginia, and the latter are not surpassed by any springs of this character found abroad. We long ago found sulphur and its compounds useful in parasitic diseases of the ear in the form of a hepar-sulphuris, not sulphurated lime, which in furunculous otitis is almost a specific.

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* International Congress, 1876.

The pain which attends furunculous otitis is very great, sometimes extending to the middle ear, and membrana tympani. It is relieved by incisions and instillations into the meatus of a warm solution of hydrochlorate of cocaine, five to ten grains to the ounce of water. This agent has been employed in this city with success.

A few cases before, and some after, being incised require a moderate dose of morphia and atropia hypodermically ($\frac{1}{4}$ grain morphia sulphas, $\frac{1}{150}$ grain atropia sulphas). In the treatment of acute naso-pharyngeal and tympanal catarrh, we wish to call attention to the fact of the great benefit to be derived from the judicious use of the tincture of aconite in two- to five-drop doses; also, to sulphate of quinine or cinchonidia in from eight to ten grains daily, in subdivided doses, combined with the compound ipecac (Dover's) powder, in from five- to ten-grain doses, with hot foot-bath at night.

Acute and chronic catarrh of the middle ear, one of the tedious and difficult diseases to cure, is the result of cold. There is an acute or subacute inflammation of the fauces, which become swollen, red, and dry. This condition, passing into the tonsils, involves the half arch of the soft palate, and travels up the Eustachian tubes or downward to the chest. This condition may have existed for years with constant relapses, the whole appearance of the throat and orifices of the Eustachian tubes never becoming unnatural, and often clogged with tenacious mucus, or even by pus, also occluded by patches of enlarged follicles. At other times the disease is found chiefly in the middle ear, in which, after the acute stage, there still remains fluid. This condition will be benefited by aconite, but it must be combined with belladonna. The dose is from one to three drops of the tincture of aconite with five drops of the tincture of belladonna every three hours.

The action of aconite on the circulation and respiration is somewhat remarkable in catarrh. After a few doses of one to five drops of the tincture of the root, or the $\frac{1}{140}$ of a grain of the nitrate of aconitine, the number of the heart's beats are reduced to one-half the normal standard, say to forty in the minute, while it renders the breathing very much slower. The success of this treatment will depend upon the care with which it is followed up by a careful hardening and cleansing of the parts with the following preparation, recommended by C. Seiler, M.D.:

℞.—Soda Bicarbonate,
Soda Biborate, āā ʒi;
Listerine, f℥i;
Glycerine, f℥i;
Water, q. s. Oij. M.
S. Draw up from the hollow of the hand, or apply with the spray.

Also by means of cold applications outside the throat and inside, such as the glycerine of carbolized iodine, tincture of aconite and glycerine, when subacute or chronic, accompanied, above all, with the free use of tinct. guaiaci amm., thirty to sixty mins. every three hours in milk, with quinine, in conjunction with nourishing food and out-door exercise in fine weather. Now, there is a certain caution to be used in the use of aconite and belladonna: do not exceed the full dose in the twenty-four hours, nor trust the patient or nurse without careful watching.

Aconite affects the muscular substance of the heart, and also the ganglionic nerves. Now, how will aconite act so as to be useful in ear diseases? In acute catarrh of the middle ear, with tonsillitis, in which the skin is dry, hot, and burning, its judicious and careful use causes the skin to become moist, and subsequently bathed in a profuse perspiration. Acute otitis media, associated with pharyngitis, rarely fails to succumb in twenty-four hours, and the tonsils from being livid, red, glazed, and dry, will become reduced in size and bathed with mucus. And then, by the proper use of the spray or gargle of astringents (one-half teaspoonful of the ammoniated tincture of guaiac in milk every two or three hours), with Politzer's air-douche or the Eustachian catheter, the noises, pain, and deafness will disappear.

Another agent which has been found useful is digitalis, which influences the ganglion nerve-centres of the heart and capillaries in such a way as to impart steadiness and force to the muscular fibres of the former, and improve the elasticity to those of the latter, thus causing the streams of circulation to move with an equable and natural current into and out of every organ.

By this regulation of the cerebral current of circulation, various functional disturbances of the brain, ideal as well as sensory, like delirium, pseudopsia, tinnitus aurium, are ameliorated or permanently removed.

As it is slow and cumulative in its action in the system, it must be closely watched.

Quinine, or the salts of Peruvian bark, if the dose is large enough, acts on the auditory nerve-centres, producing temporary tinnitus aurium or subjective sounds, which are modified by the use of hydrobromic acid in combination. It is also true of quinine, that it is curative in certain forms of ear diseases of an intermittent character, or malarial neuralgia of the third branch of the fifth, or trifacial nerves. Also in distressing tinnitus aurium arising in certain furunculous diseases of the ear, in which the noises are a reflex irritation or action of the nervous system.

Strychnia and its salts are agents which act in producing reflex action of the nervous system, and especially the spinal nerves. By its use, loss of power, or paresis of the auditory and other nerves which supply motor and sensory action to the ear, is relieved or improved. Strychnia is best administered in granules of $\frac{1}{60}$, $\frac{1}{80}$, $\frac{1}{100}$, or $\frac{1}{200}$, or hypodermic injections of the sulphate, beginning with $\frac{1}{60}$ of a grain daily, and gradually increasing, till, by the end of a month, the system of the individual may become, as we say, so tolerant as to bear one-quarter of a grain, not to be increased; yet we have known, at such a time, a slight contact or blast of air to produce convulsions or cause complete rigidity. The centres of the frontal lobes and the cerebral sensory centres both of sight and hearing are less amenable to the influence of strychnia than the spinal cord.

The bromides of potassium, sodium, lithium, and ammonium exert upon reflex action an influence the opposite of that induced by strychnia; in diseases of the ear, they modify it, and their influence extends to the sensory and ideal centres. It is possible by these agents to dull without destroying the reflex sensibility of the nervous system, and to act directly upon the cerebrum and spinal nerves, so that the visual and auditory centres perceive sights and sounds and report them to the frontal lobes, where they are received with indifference. Another phenomenon which follows the administration of the bromidal preparations is that of sleep. This has been produced by its action on the vaso-motor nerves: producing contractions of the capillaries, and, especially so, of those of the brain, also an eruption on the skin, if given in too large doses. Bromide of potassium in very large and repeated doses, on account of adynamia, which it sometimes causes, must frequently be suspended. It should be taken after meal-times in a tumbler of milk.

Bromide of sodium is a milder preparation, more easily borne by the stomach, and is to be preferred in the cases of nervous women, old people, or children, as it can be added to soup in the place of common salt. This can be employed in the various forms of nervous affections of the ear, in the dose of fifteen to thirty grains in solution with syrup or elixir of red rose of the United States Pharmacopœia, as it is readily deliquescent, and will not keep in powder. The bromide of ammonium is a more stable preparation, and is best given with syrup of orange peel, in doses from one-half to two drachms daily.

Borate of sodium will sometimes take the place of the bromides in epileptic and other convulsions. This acts well in all spasmodic affections of the throat, larynx, and glottis in children as well as in hysterical persons, who often suffer from subjective noises in the brain and ears. Then there is another of the class which is termed the *brominated camphor*. This, like the hydrate of chloral, is an antidote to strychnia, in doses of fifteen to thirty grains; also useful in nervous palitations of the heart, in three and one-half to four and one-alf grains, several times a day. It has also been found useful sexual excitement and pollutions, attended with various oises in the head or ears, but, in very stubborn cases, the romide of potassium with opium or tincture of veratrum iride (two or three drops on sugar, continued until slowing f the pulse is attained) is sometimes more satisfactory. In ritation from cold of the throat, nose, or bladder, in doses f from three to eight grains, we have found the bromated mphor to remove the annoying difficulty. The *bromide of nc* is to be prescribed only in pill, from one and one-half to vo grains, and gradually increased to six grains. It is found articularly useful in hysterical muscular spasm of the ininsic or extrinsic muscles of the ear.

Chloral hydrate is very valuable in the pain of megrim, avus, and sick headache, in five-grain doses every three hours. his agent is also very useful, when associated with the broides, in neuralgia of the fifth, also the occipital and auricur nerves of the ear, but care must be employed in its use, s it produces disturbances of the heart and temporary loss f vision.

ANTISEPTICS IN EAR DISEASES.

In search after a perfect antiseptic, numerous experiments ave been made. The insufflation of various powders into e meatus, and down upon the diseased structures, was tested. alc lessened the suppuration and seemed to be antiseptic in s action. The persalts of iron, when used in alcoholic soluon, formed hard blackish masses in the meatus and in conct with the diseased structures. Therefore, despite the fact at this solution was very nearly a perfect antiseptic, its use ad to be abandoned because of these masses tending to cumulate in the ear with the continued use of the remedy.

Iodoform in a very fine powder failed in most cases to rrest putrefaction: while in a few cases in which it did, its isagreeable odor was an objection to its employment; borac acid was then used in an impalpable powder, and, by acking the meatus tightly with it, excellent results were obined. But the subsequent syringing of the ear with tepid ater was followed by a return of the discharge and irritation.

The ear-syringe was found to be used too often and without due discrimination, in the suppurative forms of ear diseases. We have, therefore, given up syringing the ear with pure water in cases in which antiseptic treatment was to be carried out, preferring to cleanse the tissues with absorbent cotton, or when this does not suffice, by gently syringing the parts with a solution of borate of sodium, boracic or carbolic acid. The ear should be cleansed in the best way possible. Absorbent cotton should be used by preference, or a saturated solution of boracic acid. The acid must be packed down into the meatus, and the dressing must not be changed unless it be stained with discharge. All cases of suppurating ear could be treated in the way indicated; and if properly applied, no danger follows the closure of the meatus by powder.

In many of our chronic cases of profuse suppuration, the first dressing has remained in the ear for weeks, and without being stained. This shows clearly that all putrefactive action had ceased with the application of the boracic acid dressing.

Statistics show the favorable action of this treatment upon a large number of cases of otitis media purulenta acuta; the average duration of otorrhœa was very much reduced. Of one hundred cases of otitis media purulenta, the average duration of treatment, to the cessation of all discharge, was from five to thirty days.

Ofttimes one packing was enough. In other cases, the packed powder was washed out by the discharge in a few days, but we persevered, and have always been rewarded for any trouble in filling and packing. If the discharge ceases and leaves a hardened mass of powder, etc., filling the meatus, it must be removed, but not by force nor by syringing. It must be softened by the instillation of warm *fluid cosmoline* (petroleol), which has the charming recommendation of not becoming rancid by heat, etc. As the mass softens, it may be delicately picked loose, and blown out of the meatus by the rubber bag of a Politzer's air-douche.

Perforations are healed, and large ones at that; tympanal mucous membrane becomes almost normal in appearance;

hypersecretion and all odor is removed, and "running ears" are absolutely cured by this most valuable antiseptic agent.

Solutions of boracic acid in equal parts of glycerine (which will partly dissolve it) and water—forty to eighty grains of the powdered acid to the ounce—are to be recommended in acute purulent inflammation of the middle ear, or even in chronic purulent inflammation, occurring in small and unruly children. In either case, such a solution, which we designate "aqueous solution," should be *warm, well shaken, and dropped into the ear once or twice daily.* Where perforations do not heal on account of their great size, or where there is sclerosis of tympanal mucous membrane, etc., we recommend most highly, *powdered boracic acid* suspended in fluid cosmoline in varying proportions, *warmed*, *shaken*, and dropped into such ears once or twice weekly.

Silver and hard rubber instruments used in aural surgery should be kept in powdered boracic acid.

The pulverized acid has the advantage of producing no reaction on the mucous membrane, of withdrawing the water from the membrane and keeping a concentrated solution in contact with the inflamed surface, and of not forming coagulations with the secretions.

Dr. Lowenberg (Paris) used absolute alcohol, ninety-eight per cent., as an antiseptic. He never applied it in this strength at once; he diluted it first, but many of the patients were soon able to bear the use of the absolute alcohol.* When the ear has been badly cleaned out, the epidermic fragments extracted from the meatus were surrounded by a concentrated layer of micrococci.

M. Pasteur found special microbes in boils. Dr. Lowenberg found the same in furuncle of the ear.

Absolute alcohol is most valuable in polypoid growths and granulations.* In cases of otorrhœa complicated by phthisis of the lungs, the boracic acid has no effect upon the discharge. Navarro, of Turin, favored weak chloride of zinc solution, one to two grains to the ounce of water, for the same purpose. Frankel finds, that of fifty autopsies of phthisical patients, twenty-nine of them presented tubercular changes in the ear or naso-pharynx. Politzer used, with good results, the salts of lead and zinc, in cases which resisted all other means of treatment. A careful disinfection of all instruments employed in the ear, by the means of a weak solution of permanganate of potash or carbolic acid, should be observed. We shall conclude this practical introduction, with some recently published observations of ours, which were addressed to the students of Jefferson Medical College.

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* Equal parts of water, glycerine, and strong alcohol (as suggested by Knapp) to forty, eighty, or one hundred grains to the fluidounce, constitute the "alcoholic solution."—Powdered Boracic Acid in the Treatment of Chronic Purulent Inflammation of the Middle Ear (Otorrhœa), by Charles S. Turnbull, M.D., Ophthalmic and Aural Surgeon, German Hospital, Philadelphia, page 11. 1882.

PROGNOSIS IN DISEASES OF THE EAR.

In diseases, the prognosis is a matter of the greatest importance. You make this a matter of careful study, and commit to memory the prognosis in most of the prominent diseases, so that you may inform your patients as to the chances, based on carefully-recorded experience of others, and after a time, when you have had a sufficient number of cases, on your own account. We will refer you to our teachings on this subject, and will advise, in passing, not to give a hasty prognosis in any case, for it will depend largely upon the severity of the attack, the general health of the individual, the hereditary tendencies, and upon the duration. The great majority of practitioners, and we may say, with truth, even many general surgeons, are not well informed as to the nature of obscure diseases of the ear, and some of them are not even provided with proper mirrors or a speculum to examine the ear, nor with a suitable text-book, so as to understand how the ear should look in health and when diseased. Indeed, but few can tell a purulent otitis of the middle ear, with perforation of the membrana tympani, from a diffuse otitis of the meatus, and they constantly confound it with chronic suppuration of the external auditory canal; again, in summing up from my tables, the cases show that, instead of external disease of the ear, the majority of cases are serious and dangerous diseases of the internal and middle ear, for we find there are seven hundred and forty-two cases of chronic inflammation and suppuration of the middle ear, to one hundred and thirty-eight cases of chronic inflammation of the external auditory canal. We are constantly receiving from well-educated physicians, cases, which, most unfortunately for the patients, illustrate this want of knowledge. A few lectures and demonstrations on the patients received at our clinic would most effectually prevent such dangerous mistakes.

CHAPTER XXI.

DESQUAMATIVE INFLAMMATION OF THE MEATUS AUDITORIUS EXTERNUS, MEMBRANA TYMPANI, AND MIDDLE EAR.

Owing to the mistakes made by the young physicians when this class of desquamative inflammation of the epidermic layer of the ear present themselves, we consider it of importance that they should have some more definite information in regard to this class of disease of the ear, as it is almost always either omitted or confounded with accumulations of cerumen. Indeed, when first observed, it is in nearly all the ordinary cases a deep layer of epithelium covered with a layer of cerumen, and until this layer is removed the true character of the disease is not discovered. We will, therefore, report a few cases which will illustrate its various forms.

Case I.—I. W., aged thirty-five. Paying teller of a savings-bank, and closely confined to a heated office all the morning, yet fond of driving in the open air in the afternoon. He has been troubled, from time to time, with fullness in and about the ears; with deafness in the right ear, the result, he thinks, of cold air striking on that ear, owing to the opening and shutting of the door of the bank. The gentleman would relieve himself temporarily by picking a white mass from the auditory canal. In September he found his deafness in the right ear so great that when spoken to in an indistinct or low tone he could not hear, so that he had to turn the left ear. He had some pain in the upper part of the ear and temporal region, extending at times deep into the interior of the ear. The tinnitus was very distressing, and much increased during the night, so that it was difficult for him to get to sleep, causing restlessness; on waking, was not refreshed. On account of the pressure of his duties at the bank, he had not, up to this time, been able to take a holiday for treatment.

On testing his hearing, a watch could only be heard two inches from the ear. The tuning-fork, placed on the head, was heard very loud in the right ear. Upon examination, the auditory meatus was filled up with a white-gray, firm mass, especially at the junction of the cartilaginous and bony portions of the anterior portion, where it was very dry. After removing a portion of it, the patient was directed a warm solution of bicarbonate of soda (gr. xx to ℥j of equal parts of glycerine and water), applied warm every fifteen minutes, three times daily, and, later, to close the meatus with a pledget of cotton.

We also directed him the following ointment: hydrarg. ox. flav., gr. ij; vaseline, ʒij; morphia sulph., gr. ij, to be applied by means of a pledget of cotton on the end of a pointed piece of wood, introduced and rotated, not allowing the cotton to remain, but putting in its place a woolen pledget, by which the patient was able to hear, and also assisted in keeping the parts moist. By washing and picking out the white mass, from time to time, with the assistance of the forehead mirror, we gradually removed, piece by piece, the diseased epithelium scales, which floated in the water like moist paper, and presented none of the yellow or brown fatty appearance so characteristic of cerumen.

It was so brittle that when caught by the forceps only a part would remain in the blades. When the adherent mass had been removed from the junction of the bony with the soft parts of the meatus, there was found a cavity containing pus, running upwards and inwards, which clearly indicated the point of pain. In most of the cases which we have studied, pain in the ear is the exception and not the rule. It was not for many weeks that this abscess, from the pressure and irritation of this tumor-like mass, gradually healed under careful cleansing and the use of a strong solution of nitrate of silver applied to the part by means of cotton on a platinum wire introduced on a Gruber tenotome handle. We directed the patient to employ at home a solution of gr. x sulphocarbolate of zinc, to the ℥j of water, by means of a pellet of cotton, to the granulating surface. When, at last, the membrana tympani was seen and the middle ear inflated, it was found to be only slightly opaque, having been treated in time. It was only when the last of the false membrane was removed, and parts relieved from their water-logged condition, that the intense tinnitus aurium ceased.

The hearing was not much improved till the month of November, when the membrane became free, dry, and assumed its normal healthy aspect. He was then directed to use, as a precautionary measure, the ointment before mentioned, and put the pledget of clean wool in his right ear when riding in his carriage or street cars, or walking out in bad weather. As a rule, in pleasant weather or in-doors, nothing should be kept in the ears; but if the parts are very sensitive, or there is a perforation, a small, loose pledget of carded clean wool is the best agent to employ, as it never packs.

CASE II.—R. W. C., aged thirty-seven, applied at my office January 9, 1884. He is by occupation a druggist, from the State of Delaware, unmarried, and father and mother living. Neither of them is deaf. He has a brother who suffers somewhat from catarrhal deafness. The patient's general health is good. The right ear is the one affected, and the duration is three years. It followed an attack of pneumonia. He has no pain or discharge. Has singing, bell-like sounds all day, and at night it is like the blowing-off of steam. He has employed various agents in the ear, recommended by friends, as glycerine, sweet oil, etc., and, under the direction of a physician, it was syringed out several times. Examination revealed the epithelium of the meatus thickened and altered, the membrana tympani slightly opaque and sunken, and the Eustachian tube closed. Hearing distance of the right ear for a thirty-feet watch, only on close contact. The mucous membrane of the nose tender and swollen. The patient is subject to rheumatism.

Diagnosis.—Desquamative inflammation of the epithelium lining the auditory canal extending to the membrana tympani.

Treatment.—Removal of the diseased epithelium by means of the alkaline solution. After numerous applications, the whole of the foreign material was removed, when the surface of the auditory canal was found red, abraded, and tender, and membrana tympani opaque. The unguentum hydrarg. ox. flav., with tonic and astringent applications to the membrana tympani, was continued, and gradually the hearing improved. By the 18th of February, when the Eustachian tube was free, he heard the ordinary watch at nine feet.

CASE III.—This patient was Thomas G. R., aged thirty-eight, a salesman in a large dry-goods house in Philadelphia. He applied on May 16, 1882, and reported himself well, with almost perfect hearing, January 1, 1884, and no accumulation since July, 1883. In this case one membrane was perforated from the pressure. During the year 1883 the second drum-head was perforated—being very thin—while bathing at Cape May. The treatment in this case was the same as in the two before reported, only in this case the discharge was always brownish in color, from broken-down blood-corpuscles.

There were also large accumulations of dry and desquamative material which took place along the sides of the meatus, and which had to be removed with considerable force by the forceps, leaving the parts tender from the removal of the diseased epithelium.

Dr. L. W. Fox, of this city, saw this last case when we were absent from the city during the summer of 1882. In this class of cases, after the inflammation has been apparently relieved, and we think our patient cured, there remains a strong disposition to relapse for a long time. The relapses take place from various causes, but most generally they occur during the spring, autumn, or winter, and are frequently the result of a cold in the head or from exposure. These relapses are to be carefully guarded against, as a growth of connective tissue is apt to take place in the middle ear, which impairs the power of vibration of the membrana tympani and the bones of the ear, causing more or less permanent deafness. In these cases, in which there is a perforation and an opportunity for a post-mortem, the mucous membrane of the middle ear is found much swollen in consequence of interstitial serous effusion, mixed with exudation cells, and it is sometimes ecchymosed. The fibrillæ of the connective-tissue stratum are forced asunder in the form of a net-work by the exudation. (Wendt.) The epithelium is opaque and swollen, and in places raised and peeled off. The free effusion into the middle ear consists of a thick opaque fluid, mucus and pus cells, and by the tearing of blood-vessels in the case of every sudden exudation, a great number of corpuscles are sometimes present. The exudation is not always fluid, but sometimes firm and tough. The following *is the appearance of the membrana tympani in the acute stage* of secondary attacks or relapses: the cartilaginous meatus is swollen and tender, with uniform congestions along the superior wall of the membrana tympani; also on the periphery and along the handle of the malleus, while between the handle and the periphery the parts are lustreless and gray by saturation with serum.

In the cases of rapid exudation, the epidermis will sometimes appear cracked, or, in some instances, blisters are seen, which burst, after a short time, and pour out a serous or reddish fluid into the meatus, or interlamellar abscess may form. (Eyseil.)

This form of ear disease, if promptly and properly treated, is very amenable to treatment, as in the first case, but should it become chronic, it will continue, as in the last case, from childhood, and may destroy the hearing entirely.

From a careful microscopic examination, several years ago, by Dr. Shapringer, of New York, of a mass of this material supplied from one of the cases which we have reported, he stated that it contained no fungus, but consisted of large epithelium cells, with only a small quantity of crystals of cholesterin. We are, therefore, justified in rejecting the term cholesteatoma as distinctive of their character, in order, as was well observed by Lucæ, to avoid confounding them with cysts containing cholesterin or pearly tumors, to which the name is more applicable.

In an experience and practice, chiefly in this special branch, of twenty-five years, we have found but comparatively few of the so-called *keratosis obturans*, noted and first described by Wreden, 1874. Not more than twenty-five in as many years, while the ordinary cases of impaction of cerumen, which we see every year in the clinic and hospital of Jefferson Medical College, are numbered by the hundreds, and are found in the proportion of 113 in 600 cases of diseases of the ear. Yet we do not feel like adding a new term to the present large number in use, but will class them under the general term of Desquamative Diseased Conditions in the Ear. It is a well-recognized fact that in almost all inflammatory affections of the external ear, auditory canal, and surface of the membrana tympani, which is lined by skin, there is more or less desquamation, and in some cases the canal is filled with this gray-white or yellowish-white epithelium in the form of flakes or laminæ, and when neglected or improperly treated, the layers become united by fine crystals, and are hard and indurated to such a degree that it requires weeks to remove them. The pressure which this makes first on the malleus is soon transmitted to the stapes, causing the most distressing noises and deafness, and ultimately anchylosis of the ossicles.

We have recently had two cases—IV. and V.—of hypertrophy and hardening of the epidermic layer of the auditory canal and membrana tympani under treatment, and they might well be termed "*keratosis obturans*" from the peculiar formation and great difficulty of treatment.

CASE IV.—Mary M. G., aged fifteen, Clearfield County, Pa. The duration of the first was ten years, the result of whooping-cough. The peculiar cough remained until removed by removing the cause. When first seen, she could only hear the small clock thirty feet, when placed in contact with the left ear, and ordinary tone voices not heard in that ear. The deposit we have been able to remove by dropping softening alkaline solutions for three weeks, and the use of either glycerine or acetic acid, with the careful use of the probe and forceps, the parts being illuminated by the forehead mirror. When the hardened deposit had been removed, we found the membrana tympani opaque. Later, membrana tympani clearing and free, hearing improved to five feet, and hearing for voice much improved.

CASE V.—Applied at the Aural Clinic, Jefferson Medical College Hospital, October 7, with the following history: John I., aged forty-five, residence Philadelphia, a worker in the dock, deaf for five years. The hearing distance of right ear only $\frac{5}{25}$ inches, for a twenty-feet watch. The left, only on contact. The tuning-fork not heard in air, but on the bones of the head and teeth. He has never had a discharge nor pain in the ears. The noises in his head, he observes, "like wind in a storm." The right membrana tympani very opaque, sunken, no umbo or handle of malleus seen. The left meatus filled with a hard, tough, yellowish-white deposit, and no impression was made upon it by syringing or soaking with an alkaline solution. This differed from a plug of cerumen, which, after a few days' softening by means of the same solution or warm glycerine, is washed out at one, or at least in two, operations.

November 4, after the application of the curette, eleven injections of an alkaline solution having been made during a month, the diseased product was removed in two parts, one being a cast of the side of the meatus, and the other the almost entire covering of the skin of the membrana tympani. The Eustachian tube was opened by the catheter, and vapor of ether introduced into the middle ear. Politzer's air-douche did not inflate the tube. On testing his hearing, it had improved ten feet. This patient presented himself at my clinic a second time after the operation, with still improving hearing.

The opacities following this diseased condition can be distinguished from those caused by disease of the mucous layer, since in the latter the handle of the malleus is distinctly visible, while it is almost invisible in cases of great thickening from this cause.

In his two cases of "keratosis obturans," Wreden said, in his paper on "Otitis Desquamativa," that in these rare cases there were circumscribed hypertrophy and cornification of the epidermic layer, both of the auditory meatus and membrana tympani, so that the cerumenous glands and the linear-shaped papillæ (Gerlach) in the deeper part of the canal had become obliterated, and so failed to secrete the necessary natural lubricating materials. Politzer states that he found in a syphilitic woman, forty-five years of age, a case of this rare disease, in which the epidermic layer had become hypertrophied. She was also suffering from a chronic inflammation of the middle ear. Behind the umbo there was a pointed horny growth, of about two millimetres in height, with a crater-like depression at its point, which could be removed neither by dropping softening fluids upon it, nor by a vigorous use of the probe. Beneath this peculiar formation we rarely find the membrana tympani normal in appearance. It is almost always more or less diseased, and normal hearing is very rare, so that the prognosis must be very guarded, unless the case is of recent occurrence.

We have subjected the mass removed from one of the cases of the disease known as keratosis obturans to the action of glycerine and water, and yet it is not dissolved, while the other specimen, from a case of desquamative otitis, in which the disease had not involved the deep-seated lamina, contained mixed with it the cerumenous material, which has been all dissolved out of it, showing at the bottom the slightly-enlarged epidermic scales so often met with; and, later, by ether, the fatty matter has been removed in this last specimen.

Case VI.—Obstinate case of desquamative otitis media, chronic, cured. Susie T., Milford, N. J. This young girl, when in her seventh year, had a most severe attack of malignant scarlet fever, in 1879, and was first seen in March, 1880. There was entire loss of one membrana tympani or drum-head, and but a remnant of the other. The meatus of both ears was swollen and covered with a deposit of diseased epithelium, scaly masses mixed with muco-pus, which was removed by a delicate scoop, and by wiping out with absorbent cotton and cosmoline. While performing this simple operation she became faint and sick; she was very feeble and nervous, and her heart beat in the most turbulent manner. The ears were treated, after careful cleansing, by boracic acid and various other agents, but chiefly by this acid in powder or solution. She was directed the syrup of lacto-phosphate of lime to build up her broken-down constitution. Tincture of digitalis was employed to quiet the action of the heart, using various tonics at intervals, and, at times, having to administer the emulsion of cod-liver oil, iron, and sulphate of quinia. This latter valuable remedy was given in large doses during the whole course of the treatment, with the best results, as she lived in a malarious region. The perforation in the right ear healed first, and ultimately the perforation in the left closed over. There were frequent relapses, which received long and careful treatment; but we saw this patient during the spring of 1884, with her health and hearing entirely restored, and free from all discharge.

Case VII.—E. M., aged four years, Clearfield County, Pa., applied at our office; has suffered with a desquamative inflammation in his left ear since the age of ten months, and, according to the statement of his mother, lay for three years, after an attack of malignant measles, entirely helpless and a perfect skeleton, with no hopes of recovery. At the end of four years, a friend, who had been a patient of mine, advised them to bring the boy to Philadelphia. The boy was small for his age, thin and feeble, and unable to articulate but a few words, as "mamma" and "ho-ho." He was lame on one side from weak spine. The left ear was filled with altered secretions, while the side of the meatus was covered with dried pus and diseased desquamative epithelium. He was very deaf, and could only hear a loud, familiar voice. His right ear began to discharge in 1881, from the extension of the naso-pharyngeal disease through the Eustachian tube. Both the left and right membrana tympani were perforated. In the left membrana tympani almost three-fourths had gone, while in the right there was only about one-fourth lost. After cleansing the ears, opening the Eustachian tubes, and attending to the nose, directions were given to the mother, who was young, but capable of carrying them out. He was directed an emulsion of cod-liver oil, made with lime-water, in which was quinine, with alternate doses of syrup of iodide of iron; an ointment of the yellow oxide of mercury and vaseline, to be applied to the nose, after careful cleansing, and the following wash was for the ears, after all foreign matters were removed:

℞.—Pulverized Boracic Acid, ℥ss;
Glycerine,
Absolute Alcohol, āā fʒj;
Water, f℥iss. M.
Ft. sol.
S. Drop in the ear warm, after wiping out.

Then, with finely-powdered boracic acid blown in the ear through the day, after eleven months, May 14, 1884, he returned; the discharge from the ear, none; membrane restored in both ears; hearing almost normal; discharge still from the nose, and still somewhat lame; able to talk so as to be understood by any one. Continued alterative treatment with boracic acid and fluid cosmoline to the nose. The use of syrup of hypophosphites for spine, with massage and olive oil to the body and limbs.

CASE VIII.—This patient, Helen G. M., from Trenton, N. J., visited us January 10, 1882, at the recommendation of patient VI. She was in her sixth year, and had been suffering for twelve months with impairment of hearing, with discharge of broken-down pus and desquamative epithelium. This was caused by one of the most severe attacks of scarlet fever, followed by a series of large abscesses, and her life was for a time despaired of, but by careful medical attendance and a devoted mother's care, she recovered sufficiently to come to Philadelphia, being still in a weak, delicate, and nervous condition. The meatuses were filled with dried and hardened masses of pus and mucus, mixed with scales of epithelium. Only a slight rim of the drum-head remained. She had, as in Case VI., thickening and swelling of the mucous membrane of the mouth, throat, nose, and Eustachian tubes. She was treated by cleansing agents, stimulants, and astringents; but the treatment of the ears was by the mop of absorbent cotton, and once in a long while was the syringe employed. When dry pus and a mixture of the acid had to be removed, this was accomplished by a warm solution of biborate of soda. In these and numerous other cases resorcin was tried alone and in combination with chinoline and boracic acid; but the former, in every instance, increased the irritation and discharge, and gave the patient pain.

CASE IX.—February, 1885. Bessie S., aged sixteen, Trenton, N. J. This bright young girl came under our care in 1879–80, aged fourteen years. In almost every particular she resembled Case VIII., and from the same disease, being a very chronic case of desquamative disease of the middle ear, having been under treatment, before seeing us, two years in

Trenton and Philadelphia. Her perforation was in the left ear, and involved the whole membrane except a very slight rim on one side. The treatment was the same in almost every particular. She recovered entirely, after several relapses, and from 1880 to 1885 remained perfectly well, until February, when the changes were of such a character as to cause disease of the ear, throat, nose, and chest, from simple exposure to a sudden fall of temperature of 3°, 4°, and even, as on the 11th, of 5° below zero. She noticed her ear to pain her on the night of the 9th of February. She presented herself at our office on the morning of the 12th of February, and we found the ear filled up with a mass of diseased epithelium scales, mixed with muco-pus. After cleansing it with a solution, twelve per cent. boro. glyceride, we found a minute perforation, and applied the ointment of the same to it, and directed her mother to use a powder of equal parts of boracic acid and gum arabic; at the same time, when applied, to open the Eustachian tube by Valsalva's method. We saw her again on the 14th, and again applied the ointment to the perforation, which was nearly closed. She stated that she had had no pain or discharge since, and felt well, except a little weak. She was directed sixty drops of tincture of coca, three times a day, in water.

This case, with many others, show the great tendency in strumous or tubercular patients to relapse on simple exposure of the non-protected ears, nose, and mouth to the inhalations of very cold air, and the importance of protecting such exposed parts.

In Cases VI. and VII. there was entire restoration of the membrane, from the fine vessels on the edge of the extension of the cicatricial tissue. The character of the tissue which has closed up this entire perforation is produced by the skin on the outside of the membrana tympani externa and the vessels from the mucous membrane, which is the lining of the middle ear.

What is the vibratory power of such a membrane? It is the best artificial membrane that we can have; it makes a shut sac, and, if the stapes is not lost, we may have comparatively good hearing, as in Cases VI., VII., and VIII. If the perforation is large, and of long standing, it requires stimulation with nitrate of silver or some other agent, to the edges. By keeping the Eustachian tubes open, the adhesions are not so apt to form, or the membrana tympani to become attached to the promontory.

The mothers in Cases VII., VIII., IX. were very intelligent ladies, and assisted in carrying out my directions with entire fidelity, to the comfort of the patient and success of the treatment. These patients visited my office as often as we deemed it necessary.

We received the following letter in regard to this case (No. IV.) after her return home, and we print it, as it forms part of the history. In our reply we directed the physician in charge to use the powdered boracic acid to remove the exuberant polypoid granulations:

"The young lady, Miss Mary McG., who was under your care during October and November, began to suffer a good deal from her left ear, a short time since, and she came to me. She has asked me to write to you and state her condition, as you desired to hear from her. Found a fleshy mass occupying the external meatus, and protruding from it. The parts were tender, and bled easily. After some anodyne applications the mass, which was taken for a polypus, was removed almost entirely by means of a wire écraseur. After its removal was able to get away a lot of what seemed to be sebaceous material, covered with a pellicle, which, however, was only epithelium.

"These procedures being quite painful, and having occupied some time, have not succeeded in exploring satisfactorily the deep parts yet, but presume will be able to do so after a while. Except for this your treatment has been followed, (Applied locally a solution of ten grs. to oz. of silver nitrate, after taking away the growth.)"

CASE X.—Desquamative inflammation of the middle ear in the case of a physician, and reported by him.

"Dr. J. S. W., aged forty-nine years.*

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* "I was forty-nine years when I had the second attack of otitis media pur., in January, 1883."

"*History.*—Ancestors on my father's side generally healthy, so far as can be ascertained. Father is still living, being past eighty-six years of age, and has enjoyed good health, except an occasional attack of catarrh. He has had two attacks of phlegmonous erysipelas in his old age. There is a taint of scrofula on my mother's side. Grandmother died of consumption, and my mother was affected with a scrofulous ulcer of the leg for about thirty-five years. She died at the age of seventy-seven years. Father's hearing has not been good for more than twenty-five years.

"I have been affected with boils occasionally, and sometimes abscesses, from my early boyhood. In the autumn of 1872 I had a phlegmonous inflammation within the auricle and external auditory tube, ending in suppuration.

"About the latter part of January, or beginning of February, 1881, I had an attack of naso-pharyngeal catarrh, or inflammation of the mucous membrane of the air-passages, which continued to grow worse by exposure during the practice of my profession. The inflammation did not extend to my lungs, and I continued to drive out until attacked with a severe, deep-seated pain in the head, which continued, with occasional intermissions, for two or three days, when both ears commenced to discharge pus. The attending physician did not examine my ears with a speculum, and thought that there was no perforation of the membrana tympani of either ear." [We examined the ears in the spring of 1884, and saw that there had been a perforation of the left membrana tympani, which had healed.]

"The discharge from the ears continued for about three weeks. I had them cleansed by syringing with a solution of carbolic soap."

During convalescence there were two things we recommended,—that was, to use tonics and alteratives that have a special influence upon the mucous membranes. We recommended ten-grain doses of muriate of ammonia, with a warm application of a mild solution of the same. We also advised that his special cachexia must be attended to; if anæmic, use tonics. Gradually recovered, but was still affected with a chronic nasal catarrh.

On the 28th of January, 1883, had an acute catarrhal attack following exposure in the rain, ears not being protected, and head only protected by a rubber hat. The discharge from the nostrils was very profuse at first, but in a short time it commenced to subside. Had chilly sensations, which were soon followed by a severe, deep-seated pain in the head. Was very restless, especially at night, but did not send for a physician for two or three days after was taken sick. Applied a blister over the right mastoid process, as the right ear was principally affected this time. The blister remained on longer than the usual time, but did not vesicate; and, the right ear commencing to discharge pus, the blister was abandoned.

An examination of the right ear with a speculum showed a perforation of the membrana tympani. The discharge was very profuse and of a greenish color at first.

Tinct. ferri chlor. was prescribed, the bowels to be moved by infusion of senna, and morphia sulph. was given at night to produce sleep. A nourishing diet was used. After the discharge had continued several weeks so profuse as to require dressing about every three hours, day and night, equal parts of salicylic acid and carbonate of magnesia were blown into the ear, but it did not have any effect in drying up the discharge. Powdered tannic acid was also used, without lessening the discharge, but it made the ear more painful. After the discharge had continued for more than a month, a swelling was observed over the right mastoid process, which increased slowly in size at first and spread over the back part of the head, on the right side. A solution of nitrate of silver (gr. xx to water f℥j) was applied over the swollen surface, which reduced the swelling considerably, but it returned. Tinct. of iodine was also used to paint the mastoid region, but it did not materially reduce the inflammation.

A weak solution of carbolic acid* was used for syringing the ear, and the strength of the solution gradually increased as strong as it could be borne, which appeared to have a beneficial effect. Cantharidal collodion was applied over the mastoid process until it vesicated, and the surface was kept raw by repeated applications of it. The blister appeared to act favorably, as the swelling and discharge decreased. A physician friend who was first called being unable to attend any longer, another was consulted, who prescribed iodide of potassium (gr. iij) in comp. syrup of sarsaparilla three times daily. The discharge lessened rapidly under the effects of this medicine, but it returned, and the swelling over the mastoid process and back of the head, on the right side, increased to a greater extent than ever before. Being called again, his friend increased the dose of iodide of potassium to gr. v, three times daily. The discharge and swelling again rapidly decreased. The blistering was repeated.

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* These remedies the patient used on his own responsibility, and not by our advice.

In May, 1883, he wrote to us for advice. We recommended the ear to be cleansed with a four per cent. solution of boracic acid, used warm, afterwards the Eustachian tubes to be inflated, to drive the pus into the external meatus, then dried thoroughly, and boracic acid, in impalpable powder, to be blown over the suppurating surface.

We advised him to stop blistering. He continued to take the iodide of potassium and syrup of sarsaparilla comp. We told him to do an office practice and to drive out in fine weather, in daytime only, and to protect his ear with a little mass of wool.

Our treatment appeared to act favorably, as the discharge ceased *permanently*. We advised him to come and see us in July or August. About the middle of August, 1883, called to see us in Philadelphia. We made a careful examination of the ear, and found that the membrana tympani had entirely healed. We prescribed the following:

℞.—Sulphate of Zinc, gr. j;
Powdered Boracic Acid, gr. l.
M. S. To be blown into the posterior nares.

Ear continued well during the winter of 1883–84, and on April 16, 1884, went to Philadelphia to attend the post-graduate course at the Jefferson Medical College. During his attendance as a student at our office we examined his throat, nostrils, and ears. We found an old perforation of the left membrana tympani, which had healed. We prescribed the following for a nasal spray, to be warmed when employed:

℞.—Biborate of Soda,
Bicarbonate of Soda, āā ʒij;
Carbolic Acid, gtt. xx;
Water, Oj. M.

℞.—Tinct. Chloride of Iron,
Powdered Alum, aa ʒij.
S. To be applied to the throat and uvula.
Internally, Fld. Ext. Malt and Compound Syrup of the Hypophosphites.

This patient recovered so as to be able to return home well at the end of the session.

CONTRACTIONS OF THE EXTERNAL AUDITORY MEATUS.

Contractions of the external auditory meatus are caused by infiltration of its lining membrane, by cicatrization after diseases of the ear, as chronic eczema, frost-bite, etc., injuries, burns, or by exostosis and hyperostosis, and new osseous formations in the walls of the meatus.

In a few instances the contraction is congenital, as in many cases we have seen there is not an entire absence of the auricle or external ear, but it is a rudimentary form.

It will be noticed that there are but three rudimentary portions of the auricle, the two upper being projections of cartilage, and the lower one having a curved appearance.

There is no lobule, and in the space where the concha and meatus are usually found is a plain surface covered with skin, the auditory canal being wanting.

There seems to be a depression in the locality where the meatus should be. This is the cicatrix after an attempt to open the tube, a circular piece of tissue having been cut out, but the space was persistently filled up. The tragus is entirely wanting; therefore there was no guide to the operation, although the physician, a very intelligent one, who sent the case, thought that he could feel the cartilage which formed but we were not able to do so. On testing the child's hearing for that (the right) ear, it was noticed that when the watch, a very loud ticker, was placed near to, but not touching, the ear, his eye brightened, and he looked as if he heard. The same result was noticed with the tuning-fork, even when the face was turned from it.

When you examine little children for hearing, before they are able to talk, you can never arrive at a positive conclusion in regard to it; you will have to rest satisfied with an approximation, and this was all we could do in this case. It is sometimes one of the most painful duties which a physician has to perform, to decide and state the fact that the child is absolutely deaf. The parents and friends of such children often deceive themselves with the idea that the child hears when loud noises of various kinds are noticed by the child, which is usually the result of simple concussion and vibration of the air or floor. When testing such cases, the eyes of the child on which the experiment is made should be turned from the cause of such noises. To be absolutely sure, it is well to test the hearing in the dark, but by no means allow the child to see the watch, tuning-fork, bell, etc.

The prognosis in this case, therefore, was very guarded, the only favorable feature being the hearing on the right side, when the opposite ear was carefully closed. After the removal of a piece of skin, connective tissue, etc., the probe was introduced, and sunk into a depression of half an inch, but no cartilage or bony meatus was found. This opening was then filled with patent lint saturated with carbolized olive oil, and every means taken for thirteen days to keep the parts open.

The parts being healed and filled up, the little patient was again placed under the influence of the anæsthetic, the parts freely opened, and a leaden tube was made to fit the opening. A letter was directed to the family physician who sent the child, to try to keep the parts open. This was conscientiously performed, but with all his care the parts filled up, leaving but a depressed cicatrix.

Now, what is to be learned from the history and the operation in this case? First, it is proved that there was no cartilaginous portion beneath the skin forming the auditory canal. In such cases, where there is an entire obliteration of the meatus externus, there has been found by careful dissection an absence of that portion of the temporal bone which forms the tympanic ring, and the lower side of the bony canal of the meatus; and the extension backwards of the articular and true glenoid portion of the temporal bone is twice its natural breadth. The next class is a cutaneous closure of the external meatus, and with such there is sometimes a contraction of the osseous walls, which may be relieved by opening the canal with the knife, and subsequently dilation by oiled lint, compressed sponge, or bougies of laminaria; in this way we have restored the hearing of more than one patient. The parts, however, are so apt to contract that it may be, and sometimes is, necessary to fill up the auditory canal with a gold- or nickel-plated funnel-shaped tube until the parts heal. On examining the left ear, in another case, we find that where the auditory canal should be the place was covered by a smooth skin. In every other part the ear, although smaller, was almost perfect, and the patient's hearing was almost the same (good) in both ears. The mother stated that the cause of the deformity was owing to the fact that a child, while sleeping with her, had placed its foot on her (the mother's) ear. She was suddenly aroused from her sleep by the strange feeling, and supposed it to be a rat. This circumstance had occurred during the woman's pregnancy. By means of a crucial incision and the use of the leaden tube, the meatus was restored in this case.

In another class of cases there is narrowing or closure of the external auditory meatus, caused by tying cap-strings or ribbons behind the ears. A case exists of an old lady where there is nothing but a slit, caused by the constant pressure of cap-strings passed behind her ears and tightly tied under the chin. This is the form of contraction of the cartilaginous meatus where all the secretions are retained, and produce deafness and chronic eczema of the meatus, with an accumulation of cerumen, epithelium, etc. This variety requires repeated and careful syringing to keep the ear clean, thorough drying of the parts, and sometimes a quill or metallic tube to keep the walls of the meatus from collapsing.

We still have another variety, in which the canal becomes more or less obstructed by *osteosis, or bony growths*, and this, from retained secretions or pressure, causes deafness and serious trouble also. The growths are sometimes removed by means of a perforator or hand-drill. The continuous galvanic current has also been applied after the removal of any skin covering. Two or three needles may be used, and perhaps passed into the bony mass, after first drilling with a hand-drill. The application of the current may be made under the influence of ether, and after painting the parts with four to ten per cent. solution of cocaine; to be repeated from three to five minutes for a succession of days until the bone is separated. A galvanic battery is usually employed, the number of cups brought into the circuit being from ten to thirty. It usually requires two weeks of treatment. Where there is simply uniform closure of the bony meatus, without distinct rounded masses or osteophytes, they are also removed by means of the dentist's drill. Care, prudence, and caution, however, are important in employing such violent measures for the relief of those congenital and acquired closures, as inflammation is almost sure to follow; and in one case such a result was induced, and with it facial paralysis of that side.

There are two diseases in which contraction of the cartilaginous and osseous meatus occurs: the first is during and after the chronic otorrhœa; the second disease in which it occurs, although more rarely, is non-suppurative inflammation of the middle ear. And in both the result of inflammatory action accompanied by hypertrophic formation of tissue or bone, or both, occurs as well throughout the whole petrous portion of the temporal bone. This form of closure is termed hyperostosis. Gout and syphilis are considered by most authors to be the causes of these exostoses.

We have reported cases, at pp. 161, 162, where, in one, there were three enlargements of the bone, projecting into and almost completely closing the meatus, which was improved by treatment with the solid nitrate of silver, etc. Another case was operated upon by narrow chisels applied directly to the base of the exostosis, with previous incision of the skin, and it required strong blows with a wooden hammer to remove it. The case did well after the acute inflammation had subsided and the granulations had been reduced. The patient was left with a good-sized meatus and fair hearing after protracted local treatment.

A still more recent case was treated successfully by the use of the laminaria tent charged with boro-glyceride ointment. The mass was of a conical form, looking like a polypus, and was the result of acute inflammation. It required very prolonged treatment by various agents and the constant use of laminaria tents, but, ultimately, the patient recovered so as to give him a sufficient space for the sound ($\frac{7}{8}$ in.) to enter, and his hearing was restored.

A very interesting case is reported by Dr. Clarke* of a cure of a large exostosis, completely closing one meatus, by means of electrolysis,—the diagnosis and the cure being affirmed by Mr. Hinton.† At the first sitting, under chloroform, two needles attached to the negative pole were inserted at the base of the tumor, and one needle attached to the positive pole at the anterior edge. A current from six pairs of plates of a Stohrer's battery was allowed to pass for three minutes. No irritation or pain followed. Fourteen days after, under chloroform, two needles with similar attachments were used for five minutes. No ill effects followed this application, and the tumor was somewhat reduced in size. Three weeks from this time, on examination, the exostosis was found to be loose, and was removed entire. The attached surface, where the needles were inserted, was seen to be absorbed to a mere point, and this point had broken off.

A case was reported by Dr. Green,‡ of Boston, which was under his observation both before and after treatment. It was operated upon by Mr. Dalby, of London, in the same way, but the result was less fortunate. A polypoid growth behind the exostosis, with symptoms of cerebral irritation, rendered the operation necessary. The various details of the operation he did not know, but the patient said he suffered extremely from acute inflammation of the ear for some days after the operation. As the result either of the electric current or of tympanic inflammation, the facial nerve on the affected side was paralyzed. When Dr. Green saw him, some four months after the operation, the exostosis had entirely disappeared. The meatus was normal, the old purulent tympanic inflammation had subsided, and the result was a most perfect one, except for the unfortunate accident of the facial paralysis, which remained without improvement. Mr. Dalby* considers that the tympanic inflammation extended to the Fallopian canal, and thus caused the paralysis of the portio dura; for if it had been due to the electric current it would have occurred immediately, whereas it did not show itself till the next morning. Since this Mr. Dalby† prefers the operation of grinding the bone away, and for this purpose uses the drill in common use among dentists.

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* British Medical Journal, December 6, 1873.

† Hinton's Aural Surgery.

‡ Boston Medical and Surgical Journal, April, 1878, p. 494.

Matthewson‡ was highly successful in the removal of a large exostosis by means of the so-called dental engine. The instrument used was Elliott's suspension dental engine, with drills of three sizes. The patient was etherized, the integuments covering the exostosis removed by a dental scaler, and the growth perforated at several points with the smallest drill,—one and a half millimetres in diameter. These perforations were then enlarged and united by the larger drills,—two and a half millimetres in diameter,—and the irregularities ground away. The operation lasted some twenty or thirty minutes.

The pain afterwards was easily relieved by warm-water douching and small doses of opiates. Purulent discharge, with swelling and granulations at the seat of operation, continued for some weeks, but finally ceased entirely, leaving a meatus of full size, through which the membrana tympani was seen. The hearing was restored nearly to the normal standard.

The advantages of the dental engine over the other method of operating, Matthewson says, are, that it is less tedious, from the rapidity of its revolutions, and less dangerous, in that the rapidity of its motion perforates with slight pressure, and the risk of slipping and injuring important parts of the ear is very much diminished.

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* The Lancet, January 22, 1876.

† Op. cit.

‡ Report of International Otological Society, 1876.

It must not be supposed that all the cases you meet with can be successfully cured or even relieved, especially that variety of exostosis with a broad base.* Another variety it is very difficult to relieve, namely, that form in which the whole bone is involved, and the orifice is so small as not to admit the finest probe. There are a few cases in which the bony growth is a simple spur in the centre of the meatus, not attended with much deafness; this class of cases I do not operate upon. Death will sometimes follow from meningitis, in certain classes reported by Dr. Green,† of Boston, as follows: "Exostosis in connection with a secreting tympanic inflammation, either catarrhal or purulent, must be regarded as a serious complication; for the case first reported in this paper is a demonstration of the fact that such growths, although quiescent for years, may suddenly increase so as to close the meatus and produce the results of retained pus. In these complicated cases there is not only risk of the exostosis closing the meatus, and so producing a caries of the bone, but, if the growths have attained merely a moderate size, they so obstruct the view of the deeper tympanic cavity that it is often impossible to make the applications to the tympanic mucous membrane which are necessary for relieving the otorrhœa. From these two circumstances, the possible closure of the meatus and the constant obstruction to the treatment of the otorrhœa, the removal of the growth is distinctly indicated; it is certainly imperatively demanded whenever they are associated with an otorrhœa, and are also known to be rapidly increasing in size."

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* In a successful removal of an ivory exostosis, which completely filled the ear canal, Dr. Knapp "no longer attacked the tumor, but the tissue in which it originated, chiseling into the bone of the ear canal." When the operation was complete, the whole posterior wall of the canal was bare. During the operation the canal was frequently syringed with a warm solution of boric acid, and wiped out with absorbent cotton. When the hemorrhage was arrested, some boric powder was put in the canal and covered with absorbent cotton. Iodoform was put into the canal eleven days after the operation. The headache from which the patient suffered was still present, and, in front of the wound, rough bone became the starting-point of vigorously-sprouting polypi, which had to be scraped away every three or four days; but by the use of a four per cent. solution of cocaine dropping upon the granulations, the removal of the granulations, hard bone, etc., was almost painless, and in six weeks the patient was free from headache, and ultimately recovered.—Archives of Otology, vol. xiv., Nos. 2 and 3, 2123, June and September, 1885.

† Boston Medical and Surgical Journal, April, 1878.

Exostoses of the meatus have been found both in South and North American aborigines. In an examination of fifty Peruvian skulls, one was found in which exostoses filled up the lumen of both meatuses. Whether these anomalies depend on certain race peculiarities, or on the mechanical irritation of the meatus, caused by wearing heavy ear-pendants, has not been yet determined. The most frequent place in which the exostoses are found is the union of the osseous with the cartilaginous section and the posterior wall of the meatus.

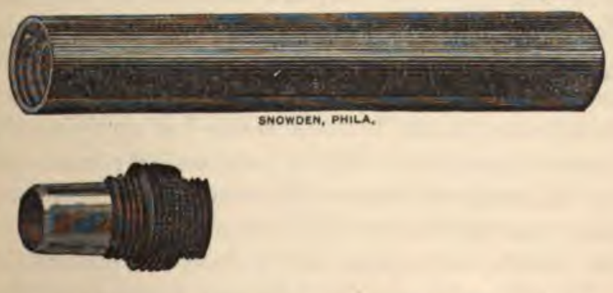
R. S. Wallace, M.D., writes of a case of contractions of the external auditory meatus which he treated last summer. "A child, some four or five years of age, while climbing up to a shelf of a cupboard, upset a can of concentrated lye, which struck him on the side of the head and ran down into the external auditory meatus, causing a high degree of inflammation, for which the parent did not deem it worth while calling in a physician.

"We first saw the case some four weeks after the accident, when the meatus was as completely closed as if there never had been an opening. We put the child under the influence of an anæsthetic, and made a crucial incision large enough and deep enough to allow us to introduce the point of a uterine dilator. After dilating thoroughly, we syringed out the canal, packed it with absorbent cotton thoroughly impregnated with carbolized oil, and told the parent to return with the child in two days; but they did not return for a week, when we found the meatus nearly as badly contracted as when we first operated. Knowing the nature of the burns to contract, we decided on a different plan of treatment, and again administered an anæsthetic, and dilated as before, then introduced a piece of carbolized sponge tent, which we allowed to remain until next day, and when we removed it, we washed out the canal with a solution of boric acid and introduced a glass tube, which was made from an intra-uterine glass-stem pessary. We smoothed the ends by rubbing on a whetstone, and afterwards polished with emery. This gave us just what we wanted,—a glass stem with an opening through the centre and a flange on one end."

Observations and Experiments with the various Artificial Membrana Tympani.—On pages 293 to 299 will be found an account of the first application of the wet cotton-wool as an artificial membrana tympani, by the late Mr. Yearsley, in 1848, and his theory of its mode of action; also the value of pressure on the malleus, first noticed by Ménière, in a case in 1848.

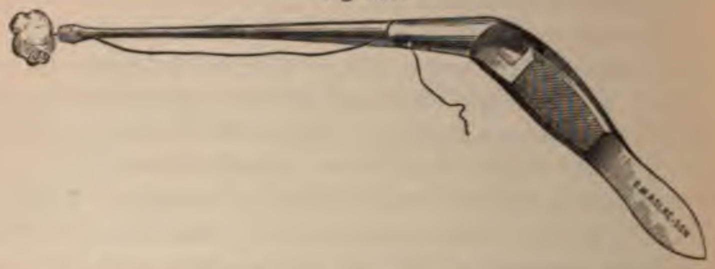
In 1859 we published an account of the use of the artificial membrana tympani of the late Mr. Toynbee, and reported some cases of our own. At page 296 will be found a cut of the form which we then employed. We soon found that the metal stem acted injuriously on exposed mucous membrane when the rubber became soft, or curled up, or separated from the metallic stem. To obviate this we covered the metal with rubber; but still this did not entirely remedy the difficulty. Various agents were tried, of different material, as paper, cloth, gold-beaters' skin, disks of gelatin, thick solutions of various agents in cosmoline, glycerine, etc. The best results were obtained by the use of pure rubber, when a slight pressure to keep the bones in place was required, or in part shutting up a clean perforation from the air. We found this form in use by Gruber in his aural clinic in Vienna, and with good results. The following cut (Fig. 106) will show a good illustration of the instrument for cutting out the proper-sized disk, by means of his punch; also the convenient form

Fig. 106.


SNOWDEN, PHILA.

of forceps at Fig. 107, so as to introduce it and let the string remain outside the ear. This we found objectionable to most

Fig. 107.



lady patients, so we remove the string, only using it as a guide for introducing the disk. The two instruments referred to were invented by Professor Gruber. The most serious objection to it is that it was so soon dissolved, or curled so as to do away with the pressure on the short process of the malleus, and became useless before the healing took place of the membrana tympani, so we were glad to have another agent which had been tried and found useful.

Dr. Tangeman, of Baltimore (*Med. News*, March, 1886), states: "I have treated a number of cases of this kind by means of a substance that will again put the tympanic cavity in its physiological condition,—render it an air-tight space." He only reports four cases. In the first, a relapsing case, after the usual treatment of one week by means of a daily cleansing with probe and cotton, the application of yellow oxide of mercury ointment, and inflation of the tube and middle ear by means of Politzer's air-bag, he then applied a strong solution of cocaine to the membrane and middle ear, to render them less sensitive.

The following is the doctor's method of applying the new membrane: A circular disk of surgeon's "rubber adhesive plaster," as nearly the size of the natural membrane as could be made, was carried to the bottom of the meatus with a delicate annular forceps, so as to close the perforation and cover the entire membrane. It was pressed in place by means of a cotton-wrapped wire until it had become firmly adherent, thereby forming again an air-tight space of the tympanic cavity; no irritation or pain followed. Hearing distance at the beginning of treatment, ten inches for the ear on the right side, eight inches on the left; when discharged, hearing absolutely perfect, not only for watch and conversation, but also for musical sounds." He states that the suppurative condition is (by others) allowed to go on with the artificial membrane into or over the perforation. We do not so treat, for in every instance we attend to all the conditions which he considers as proper, after using the artificial membrane. Including this case, he theorizes as follows: "Did this piece of thick sticking-plaster possess acoustic properties as those described by Helmholtz, of the natural membrana tympani, which were absolutely necessary to the proper perception of all kinds of sounds? Did the chain of ossicles transmit sound *more* freely now than on the second day after the application of the plaster, when the hearing was found to be little above what it was prior to the introduction of the little disk? Does it not seem that all speculations as to the position and curvature of the membrana tympani are erroneous?" In looking carefully over his statement of the perforation, there must have been some mistake about the size of it, for he says, "An examination revealed a perforation through the right membrana, almost circular in shape, about one and a half lines in diameter, situated in the lower anterior segment. On the left side the perforation was considerably larger, about *two inches*." He must mean two lines, as the normal membrane is not larger than as follows: The greatest longitudinal diameter, from the *spina tympanica post.* to the lowest point of the inferior margin of the membrane, amounts to 9½–10 mm. The greatest transverse diameter, from the anterior to posterior margin, measures 8½–9 mm.

We have employed this form of artificial membrane in five cases,—two adults and three children. It increased the hearing, but not to the degree that this author claims for it.

As far as the complete production of a shut sac, it is no better than the rubber disk without the wire or the piece of circular cloth. Its chief advantage, to our mind, is the slight pressure it gives and the protection from the air. This protection is also afforded by ointments, glycerine, boro-glyceride solution, and, we think best of all, by packing with boracic acid.

It is now a well-recognized fact that cases of perforated membrana tympani require, or should only be successfully treated by means of, great care and attention, employed so as to discriminate between each case as to condition, hereditary disease tendency, proper kind of food employed, and hygienic surroundings. We must abandon any one form of so-called artificial membrane, and discover, by careful and persistent trials, the best form adapted to the particular case; above all, as we have stated before, to protect the delicate tympanic cavity from air charged with deleterious agents, as great heat or cold, or microbe, fungi, or other living organisms.

While previously it was believed that the ossicula are pressed inwards by the artificial membrane, "Knapp thinks that, by the pressure on the short process of the malleus—which, of course, lies across the axis of the malleus—the handle of the malleus, and with it the incus and the stapes, turn somewhat outwards. The improvement in hearing is therefore produced by the chain of ossicula, which has been tightly pressed inwards, being turned outwards into a position approaching the normal one." By a series of experiments which we have made, we have convinced ourselves of the truth of Knapp's theory. If, in cases in which the artificial drum effect an improvement in the hearing, moderate pressure with a blunt probe be made on the short process, a decided increase of hearing is thereby observed; but in other cases the pressure on the short process was without result, while touching the inferior part of the handle effected an increase in the hearing.

FUNCTIONS OF MEMBRANA TYMPANI.

In a recent practical article by Sir William B. Dalby—"Functions of Membrana Tympani" (*American Journal of the Medical Sciences*)—he gives four propositions which we fully agree with: 1st. Structural changes in the tympanic membrane, of a very extensive nature, may exist without impairing hearing. 2d. Loss of continuity in the tympanic membrane does not necessarily interfere with its functions, provided that the ligamentous support which it affords to the chain of ossicles is not impaired. 3d. That loss of continuity in the tympanic membrane does not of itself interfere with its functions is still further shown by the careful and continued observation of cases in which the membrane is perforated by disease.

To illustrate more fully his propositions he gives four examples, the counterparts of which, having been repeatedly under notice, may be instanced, and in all of these the tympanic membrane has been completely lost by disease.

In the first the loss of hearing has been total; *in the second* the loss has been of so trifling a nature as to have escaped observation, and only to be detected by the most careful tests with Hughes's sonometer; in the *third and fourth* the loss has been very great,—that is, words spoken a few inches from the ear are not distinguishable.

In the third the application of a small disk of moistened cotton-wool, adjusted with a probe by the patient, gives (by effecting pressure on the stapes) hearing that, for ordinary purposes of life, is good.

In the fourth the contrivance is of no benefit.

It seems fair, therefore, to infer that the loss of hearing is due to causes which do not include the loss of continuity in the tympanic membrane.

CHAPTER XXII.

SYPHILIS AND MUMPS, CAUSING DISEASE OF THE INTERNAL EAR WITH EXTREME DEAFNESS.

THE auditory apparatus is relatively the location of the most serious and frequent effect of mumps. (See page 352.)

Absolute or temporary deafness and catarrh of the auditory meatus are the principal expressions of such localization.

I. Absolute Deafness.—This is of anatomical origin, uncertain in its nature, but resulting probably from a direct miasmatic impression, produced by the infectious principle of the disease, upon the nervous system. The deafness is characterized by—

a. Early appearance.

b. Rapidity of production.

c. Independence of glandular and other complications incident to mumps.

d. Incurability.

No appreciable otoscopic lesion is present, but the symptoms may more or less perfectly simulate those of Ménière's disease. There is no symptom by which the occurrence of deafness is foreshown, or by which the extent of the disease may be prognosticated.

II. Temporary Deafness.—As the result of mumps, clinical facts well establish the possibility of a transient deafness, different in the time of its appearance, its intensity, and its duration from that above described. It is rarely complete, and lasts usually about two weeks.

III. Catarrh of the Tympanum.—In some instances there is produced a middle-ear inflammation, similar to that of the conjunctiva or urethra.

Syphilis or Mumps.—This determination of the disease is habitually contemporaneous with the glandular affections, and is produced by a sero-purulent discharge, little different from that of ordinary otorrhœa. Its duration is relatively short, and it plays no special part in the determination of those diseases which, occurring subsequently to mumps, as well as other diseases, may result in suppuration of the middle ear.

There has been published recently a large number of cases in which various forms of defective hearing have occurred as the result or sequela of parotitis.

In the cases which we have seen, most of them are profoundly deaf in one or both ears. The deafness, when complete, has been followed by alarming symptoms of depression and cerebral disturbance, or after marked febrile affections, and with decided change in the drum-membrane, which was sunken and opaque. Yet, in other cases, the changes in the ear were not so marked. Bone conduction and the perception for low tones remained in most of them. From these symptoms and the careful study of the cases we inferred that there must have been an exudation in the labyrinth, involving also the semicircular canal and cochlea. In the history of these cases we have found but few reports of metastasis taking place to the testicle of the male or the mammæ of the female. Most had a large amount of lymph formed in the tissue of the glands, and occasionally abscesses, which should be opened promptly,—not allowed to open spontaneously by means of application of poultices.

Treatment.—We rarely see the cases until all the acute symptoms are gone, but where induration and enlargement of the glands remain after the acute stage, absorbent applications, such as inunctions of iodine or mercury, should be employed.

Deafness accompanying mumps is to be treated as an acute otitis media. In the profound labyrinthine deafness in the adult we use the hypodermic injection of pilocarpine nitrates, from three to four drops, for ten or fifteen days, of a solution containing nitrate of pilocarpine, 0.04, aqua pura 1.00, or, in

[illegible]

[illegible] lation within the laby[illegible].

[illegible] September and December, p. [illegible]

[illegible] p. 722. Cassell's translation [illegible] 188[illegible].

rub this ointment forcibly over the skin covering the mastoid process, three times a day, for ten minutes at a time.

Two cases of sudden and extreme loss of hearing relieved by the use of pilocarpine have been reported by Dr. T. Barr. (*Brit. Med. Jour.*, Jan. 13, 1885.)

CASE I.—J. M., a ship-steward, aged twenty-two, presented himself for treatment at the Glasgow Ear Hospital on August 25, 1884, suffering from almost total deafness. He was a man of pale and unhealthy aspect. Six months before he contracted syphilis, followed by secondary symptoms, for which, however, he was successfully treated. He was also somewhat addicted to alcoholic indulgence. One of his sisters suffered from phthisis pulmonalis, but the other members of a pretty large family were quite healthy.

Inquiry elicited from him the following account of the origin and course of the disease. About six weeks previously, while crossing the Atlantic on the voyage to Montreal, he was seized with great nausea, vomiting, and severe giddiness. Accustomed to sea-life, he knew that he was not liable in the least to sea-sickness. By the time the ship arrived at Montreal the sickness had passed away, and the giddiness had become much less. On the afternoon of his arrival, however, while walking in one of the streets of Montreal, the weather being extremely hot, he was suddenly seized with giddiness so extreme that he staggered and fell to the ground without losing consciousness. After a short time he recovered sufficiently to make his way with assistance to the ship. He was put in bed, and the surgeon of the ship prescribed some form of pills.

Up till this time his hearing was unaffected; and, indeed, at no time during his past life had there been, to his knowledge, any dullness or other disturbance of the hearing on either side. On the following morning, however, he woke from sleep feeling that his left ear was apparently totally deaf. As he lay with the right side of his head on the pillow, he could not hear what was said by a man speaking close beside him. But now a loud noise, like the rush of water, was constantly present in the deaf ear, as well as through the head. Towards night the hearing of the opposite or right ear seemed also to be passing away, and next morning found him absolutely deaf on both sides, so that the loud shouting of his mates, close to his head, was by him quite unperceived. The extreme giddiness continued, and the loud rushing noise filled his head.

During the whole of the voyage back to Liverpool he lay in bed in a condition of great dizziness, nausea, and total deafness. When he attempted to walk his movements were like those of a drunken man; he kept in a straight line for a few steps, then reeled from side to side. Up till his arrival in Liverpool there had been little if any pain in his head; but while in the steamer from Liverpool to Glasgow, he became affected with severe pain in the back of his head, and very especially in the region behind his ears.

In Glasgow he was placed under the care of Dr. Halket, who shaved the head and applied a cantharides plaster on the surface behind each ear. These were repeated two or three nights afterwards. There was also prescribed by Dr. Halket a mixture containing iodide of potassium chiefly, with good effect, "clearing the head and helping the stomach," as the patient expressed it.

One morning, shortly after his arrival in Glasgow, when he awoke from sleep he experienced a sensation of stiffness in one cheek, and on examination, with the aid of a mirror, he found his face drawn to the left side. The odd appearance which he presented, with shaved head and twisted face, constrained him, even in his sad condition, to smile; this facial movement rendered, of course, the twisted appearance still more striking. In attempting to drink tea or water the liquid tended to trickle out of his mouth. This facial paralysis of the right side was of short duration, passing away in the course of the same evening.

At this stage of the illness a consulting physician saw the patient and expressed an unfavorable prognosis. His state, nevertheless, began to improve. Under treatment by iodide of potassium the pain in the head diminished, and the giddiness became much less, although some tendency to stagger still continued. The deafness, however, remained unaltered, and as soon as it was practicable, about seven weeks after the beginning of the illness, Dr. Halket sent him to the Ear Hospital for treatment.

On admission, I found his hearing by both aerial and osseous conduction almost quite abolished. Words spoken very loudly into his ears could not be understood by him. In the right ear, however, the voice was heard, although the individual words could not be distinguished. He was unable to hear the loud tick of a watch on either side, pressed firmly on the auricle or on the bones of the head. The sound of a vibrating tuning-fork applied to the bones of the head was also unperceived. Objective examination of the outer and middle ears yielded negative results. On both sides the tympanic membranes presented quite a normal appearance, while the Eustachian tubes were permeable. He did not now complain of the subjective sounds. The vertigo was much less than at an earlier stage of the illness; but there was still a disposition to stagger in walking. The pain in the head was at times quite absent, but now and then it returned in severe paroxysms.

The digestive functions seemed to be much disturbed; the tongue was thickly coated with a yellowish-brown fur, the bowels were persistently constipated, while an extremely foul odor was exhaled by the breath.

He was admitted to the in-door department of the hospital, and at once treated with pilocarpine injections. One of Wyeth's tablets, containing a third of a grain of the drug, was dissolved in six minims of water and injected underneath the skin of the shoulder every second day for six days, and then every third day for nine days. Copious perspiration followed every application of the remedy. The first produced very considerable sickness and vomiting; on every subsequent occasion there was some nausea excited, but it was much less than after the first. The patient always remained in bed for a few hours after the use of the remedy.

Improvement in the hearing almost immediately manifested itself. A day or two after the first injection the patient noticed some improvement in the right ear, and this improvement seemed to go on gradually almost day by day. In three weeks after admission, he could hear and understand, with the right ear, conversation in a voice only slightly [illegible] ordinary speech. In other respects also his condition improved. He soon afterwards resumed his occupation of [illegible] on board a steamer.

On the [illegible] of April, 1885, about nine months after the [illegible] was as follows. On the right side, a watch, whose normal hearing distance is forty inches, was heard [illegible]; on the left, it was not heard even on pressure. [illegible], however, [illegible] his power of hearing speech, which was so good that persons conversing with him did not detect any dullness of hearing. A vibrating tuning-fork applied to the middle line of the head was heard better in the right ear. There were no subjective sounds in the ear or head. The tendency to stagger, which had continued for a considerable time, while in the dark, had passed completely away. The complexion was much healthier-looking, the tongue was clean, and the breath was free from the foul odor.

CASE II.—[illegible], a laborer, aged fifty-four, was admitted to the Ear Hospital on [illegible] of February, 1885. He stated that he had been suddenly affected, a fortnight before admission, with total deafness while in the act of stooping at his work. He had been out of work for some months, and this sudden loss of hearing occurred just on the morning of his return to work. His bodily health had suffered from poverty, due to the enforced idleness, while his mental condition was depressed, owing to the conduct of a reprobate son. No hereditary tendency to ear disease and no syphilitic origin could be traced. The shock of deafness, he said, was signalized by a sensation as if a pistol had been discharged in the interior of his head, and, immediately afterwards, he ceased to hear the noises in the ship-building yard where he was employed, or the voices of the workmen. This was followed by severe pain affecting the whole head, but especially the vertex, and by a sensation in his right ear, "just as if a clock was working inside." There was also slight giddiness.

On admission, it was found that a watch with a loud tick uld not be heard on pressure in either ear. The voice uld not be heard, although loudly spoken, in the right ear;

in the left it was heard, but only partially understood. Osseous conduction by the tuning-fork was faint, and the duration of the perception was short. Objective examination of the ear showed a small oval calcareous patch, evidently of long standing, on each tympanic membrane behind the handle of the malleus. These were probably the results of old catarrhal affections in the middle ears, and had no connection with this attack. Inflation of the middle ears had no effect upon the deafness. A cantharides plaster was first applied behind each ear, without, however, yielding any good result.

Subcutaneous injections of a solution of pilocarpine were then employed. The solution injected contained at first only one-twelfth of a grain of the pilocarpine, but it was increased, after three or four injections, to one-third of a grain. In the weaker form they were employed daily, but the stronger solutions were only used every third day. In all eight injections were employed. The patient remained in bed for six hours after each injection, and free diaphoresis followed. Slight sickness was excited by the strong solutions. Improvement in the hearing of speech was observed when two injections had been used, and after that there was gradual but steady improvement in the hearing, with disappearance of the subjective sounds.

On April 13, 1885, two months after the seizure, the condition was as follows: The tick of a watch heard, in normal hearing, forty inches from the ear, was heard eight inches on the right side and one inch on the left. Conversation in an ordinary tone of voice was understood without any difficulty. The osseous conduction of sound by the tuning-fork was heard rather better than the aerial,—a circumstance which was probably due to the existence of the old catarrhal affections of the middle ear. The subjective sound had completely disappeared.

Observations.—There can be little doubt that in the two cases here described, the seat of the mischief was in the nervous apparatus of hearing. It is, however, not possible to determine with certainty in what part of the auditory nerve the lesion existed,—whether in its roots in the brain, in its [illegible] power [illegible] vascular and [illegible] reality the same [illegible] In this view of its action be correct, it would be reasonable to employ this method of treatment more generally in cases of cerebral apoplexy.*

SURGICAL OPENING OF THE MASTOID.

The disposition of the present day is not to operate by perforating the bone, even in deep-seated disease of the mastoid process, or cells in which there is altered blood or pus with caries.

This procrastination, in our opinion, may be the cause of death in many instances; for, no matter what means we may employ, if this is not done, and a free vent or outlet given to the pus, it will pass inwards towards the brain, where there is the least resistance. It is certain, as stated by Schwartze, that the numerous cavities of the ear are particularly adapted for the retention of large purulent masses, which, if not removed, gradually dry up and become caseous; and this is especially the case with the antrum mastoideum of children, which is about the size of a cherry-stone, and, as it lies behind and above the tympanum, easily collects the pus when the child lies on its back, in bed. According to Buhl, tuberculous self-infection from caseous collections is most common in youth,—at the time when the body is growing, and the formation of blood and lymph is active.

You have no idea how frequently the tuberculosis of children is dependent on purulent retention in the cavities of the ear, and it is only necessary, to prove this, to examine the cavities of the temporal bone, which lie superficially just beneath the dura mater, and which can usually be easily broken open with forceps. This should be done, and greater care should hereafter be taken to prevent and remove the pus from within the ear. The following is Dr. Morpurgo's opinion of the operation: †

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* In a series of trials of pilocarpine by hypodermic injection one recent case of true labyrinthine deafness was promptly relieved, two were improved, but in a number of old cases no results were obtained. With fluid extract of jaborandi and the ointment of Gruber good results were obtained in several cases. It is worthy of a more extended trial.

† Le Operazioni da Praticarii sull' Apofisi Mastoidea. Dott. Eugenio Morpurgo, Estratto dal Bollettino delle Malattie dell' Orecchio della Gola e del Naso.—Anno III., No. 2.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

of twenty years, just reaching the most important period of his life; then follows that of twenty and thirty years. By the term "cured" he means the cessation of the purulent process and the entire relief from pain.

Schwartze states that the average duration of treatment in his cases was from nine to ten months. In the six cases not cured, the cause of failure was unsuitable mode of operation and improper after-treatment. Of the twenty deaths, six were from "meningitis tuberculosa," two from abscess of the brain, one from "pneumonia catarrhalis," three from tuberculosis pulmonum, and one from epithelioma.*

Of the cases of operation mentioned, and which constitute a small portion of the number examined by me,† the first two were operated by me; the last, owing to the social positions of the patients, were compelled to seek refuge in the hospital, and were addressed by me to my respected friend Dr. Escher, one of the few surgeons who interests himself in the progress of otology. I was able to assist at the operation and follow the course of the disease.

In only one case (Schwartze) was the operation the direct cause of death, by a splinter of bone perforating the dura mater.

As observed by Schwartze, from the history of the hundred cases (which we cannot give in detail), the fact appears that it is possible, by the perforation of the mastoid, to bring the most difficult and tedious cases of caries of the temporal bone to a perfect and permanent cure, even when the petrous portion is involved in the carious destruction.

Ninety-eight cases of perforation of the mastoid process have been collected by Poinsot (" Dict. Med. et Chirurg."), in thirty-five of which the trephine or trepan was used; in the remainder other instruments—gouge, drill, trocar, etc.—were employed. Of the total number of cases, fifteen terminated fatally; in two the result is not stated; in five there is no recorded result; five others were under treatment at the time at which these cases were reported; the rest were successful.

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* Archives für Ohrenheilkunde, xv., xvi., xvii., xviii.

† Morpurgo.

Of the thirty-five cases in which the trephine or trepan was used, four terminated fatally; in the total number of cases, the results of which are differently specified, seventeen per cent. were fatal and twenty-one per cent. successful. Buck, of New York, has collected thirty-nine cases of suppurative inflammation of the mastoid, in which the cases were left to nature (expectant treatment); thirty-four were fatal.

The Influence upon the Hearing.—This depends upon the amount of the disease in the sound-conducting apparatus of the ear proper. In seventeen of Schwartze's cases the hearing became normal; in the remaining cases the hearing distance varied from two to thirty-four cm.

On the Value of the Ophthalmoscopic Examination in Diseases of the Mastoid, with Brain Complication.—Dr. Knapp states that, in his opinion, neuro-retinitis is not a frequent symptom, but, when present, a most important symptom of brain disease, because it is objective, and is positive evidence that the inflammation has extended to the cranial cavity.

It is not only of very great value in determining the appropriateness of opening the mastoïd in many cases, but also in furnishing us a kind of barometer, whose rise and fall (that is, increase and decrease of the neuro-retinitis) will point towards aggravation or amelioration of tympano-mastoiditis.

He has also found it of peculiar value at the period when the opening of the mastoid may be allowed to close, which should not be as long as the neuro-retinitis has not yet disappeared.

Politzer states that he cannot, from his own experience, confirm the conclusion that optic neuritis and the appearance of engorgement of the retina, occurring in suppuration of the middle ear, are sure signs of already commenced secondary cerebral affection, as he has recently found such phenomena in cases in which there was not the slightest indication of a cerebral affection. Taufel observed in one case, after the opening of the mastoid process, on the retina of the affected side, hyperæmia and ecchymosis, which formerly existed, disappear.

Dr. Charles F. Kipp,* a very good authority on the subject of optic neuritis in cases of purulent inflammation of the middle ear, writes, with regard to the ophthalmoscopic appearances observed in his cases, "that they differed in nowise from those in the ordinary form of optic neuritis of moderate degree. The swelling of the optic papilla, although never very great, was always distinctly visible during the height of the disease. The color of the papilla was either reddish or reddish-gray, and the edge of the papilla was either blurred or completely hidden. The adjacent retina was more or less opaque, and it, as well as the peripheral portion of the papilla, was distinctly striated. The retinal veins were always fuller than normal. Hemorrhage and white plaques on the disk or in the retina were seen in only a few cases." The more intense form of optic neuritis, known as choked disk, which occurs in connection with tumors of the brain, he has never seen in cases of otorrhœa.

From the drift of the discussion in the American Otological Society (1884), it would almost appear as if there were no precise indication for the opening of the mastoid. Dr. Knapp† desired to state that he considers this operation as legitimate, and, in many cases, as unambiguously indicated as any surgical operation, for instance, that of glaucoma.

In cases where the indications for opening the mastoid were doubtful, he relied, more than any other symptoms, upon a *constant, intense pain* radiating from the ear and mastoid over the corresponding half of the head, sometimes more pronounced at the vertex, and at other times more in the forehead or the occiput.

On the Use of the so-called Calcium Sulphide.—Dr. Sexton‡ exhibited a former patient, now a waiter at a hotel, who had been suffering from mastoid disease, in consequence of chronic suppurative otitis media complicated with ozæna.

In this case a natural opening formed, the remnant of which is still shown by a dent in the bone, and he had kept this open until the discharge ceased. For treatment he had only given calcium sulphide.

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* Arch. Otology, vol. xix., No. 1, p. 5, March, 1885.

† Transactions Otological Society, Medical News, Philadelphia, July 28, 1884.

‡ Transactions of the American Otological Society, 1884.

In a very large number of cases of aural diseases in general, and of the mastoid in particular, he found no occasion for trephining the mastoid. He relied especially on the calcium sulphide.

If this remedy has proven unsuccessful in the hands of some of the members, it was because too large doses had been given. The dose should never exceed one-tenth of a grain. Of late, he does not apply leeches. He calls attention to the frequency of pus burrowing through the posterior wall of the meatus, and he tried to favor this process, and removed sequestra as soon as possible. He does not consider pain so important in regard to indications for operative interference; there is other evidence needed. Moreover, the pain is not confined to the mastoid; oftener the side of the tympanic cavity is the seat of pain, more than in any nerve-distribution in the mastoid cells.

Dr. Gruening remarked "that in the case shown by Dr. Sexton it was not the sulphide of calcium, but nature, to which the recovery was due, and, in order to be consistent with this theory, in place of keeping the opening made by nature patulous until the discharge had ceased, he should have endeavored to close that opening."

Dr. Bartlett said that sulphide of calcium was contraindicated in such cases, because it accelerated suppuration in every part of the body where it might be going on.

Our own experience with this agent, the so-called sulphide of calcium, or, more properly, sulphuretted lime, in mastoid disease has been perfectly negative. In one case we administered one hundred pills, from one-sixth to one-fourth of a grain, without the slightest results,—no diminution of discharge, no relief of pain, nor of the constant dizziness. In another case we reduced the dose to one-sixth and one-tenth of a grain, and continued its use without any good results. After treating a large number of cases, with the experience of many years, we believe that it is best to open the mastoid in every case in which we are reasonably certain that the cerebral disease is due to caries or the retention of pus in the mastoid antrum or the mastoid cells.

Indications for Opening the Mastoid Processes.—The most recent indications for opening the mastoid processes in cases of purulent disease of the middle ear are as follows: Purulent inflammation in the mastoid process, appearing in the course of suppuration of the middle ear, when persistent severe pain in the bone cannot be subdued by the application of the ice-bag, leeches, or by Wilde's incision.

The operation is imperative in painful inflammation in the mastoid process, occurring in acute and chronic suppuration of the middle ear, and when the external meatus and the tympanic cavity are filled up with growths.

And even though the soft parts over the mastoid are not swollen or infiltrated, the operation is sometimes indicated; or when the posterior wall of the meatus is bulging and, after incision, an abscess is not emptied, the symptoms of retention of pus continue; when the pain is persistent, and tenderness over the mastoid process, lasting for days or weeks, in which case there is probably an abscess not communicating with the tympanic cavity.

In every suppuration of the middle ear, combined with inflammation of the mastoid process, there is fever, chill, vertigo, and headache during the course of the affection, which denotes a dangerous complication, and the indications for the operation are all-important.

Drainage of Idiopathic Intra-cranial Abscesses in Ear Disease.—The evacuation of traumatic abscesses of the brain has long been a recognized procedure, and has met with a fair measure of success.

Recently, Mr. Hulke has endeavored to extend this practice to idiopathic abscesses within the cranium. A few months ago a man was admitted into the Middlesex Hospital, under Dr. Cayley, suffering from *coma which had supervened upon a long-standing purulent discharge from the ear.* There were no localizing symptoms. Mr. Hulke trephined the skull in the lower part of the temporal fossa, and, by means of a director, explored the temporo-sphenoidal lobe without result. The operation was unattended with ill results, but after the patient's death, a few days later, an abscess was found in the cerebellum. In another case, a woman with similar history and symptoms and intracranial suppuration was diagnosticated. Mr. Hulke determined to explore the brain. In this instance he made an aperture in the cerebellar region of the occipital bone, and, through a small incision in the dura mater, he passed a director through the cerebellum, in all directions, but without striking an abscess.

Finding that the symptoms were unrelieved, he subsequently trephined the temporal fossa and opened an abscess in the temporo-sphenoidal lobe.

The treatment in these cases marks an important advance in cerebral surgery.

"OTITIS INTERMITTENS," OR "MALARIAL OTITIS."

With Observations on the Use of Quinine in Diseases of the Ear.

In our report of two hundred and ninety-one cases of diseases of the ear, published in 1873, there will be found some cases of "intermittent otitis," at that time a rare affection.

We were aware that excessive doses of quinine would, in some rare cases, produce temporary deafness of twenty-four hours' duration, and we were also familiar with its use, associated with morphia, in the chill accompanying otitis media and in otalgia, but had never before employed it as in the case we are about to relate until 1873.

CASE I. "*Otitis Intermittens.*"—Miss M. H., aged twenty-one, Philadelphia, daughter of wealthy parents, fair, delicate skin, small in stature, and not robust. On father's side, tendency to phthisis. Mother stout, suffers from heart affection and irritation of brain. Is the eldest child; has had what the mother calls "a running from left ear" for a long time, and has been under the care of four different physicians. The discharge would almost cease for a time, but, after exposure, would return. She came under our care in January, 1871, and continued under careful and constant treatment until July, when she was discharged well, and has continued so.

The following were her symptoms and the condition of the ears. On examination, the surface of the meatus was found studded with minute abscesses, some of them open, others in a swollen state with apices containing a minute portion of pus. If they were large, they gave her considerable pain until discharging; they left the meatus slightly red and swollen. The membrana tympani of the left ear was opaque, the right normal. Hearing distance for low-ticking watch, on left side, only one-thirtieth; right side, twenty-five thirtieths. Discharge stains the pillow, and has some odor, which is very annoying to patient. Finding some slight dullness on percussion under one of the clavicles, and also being informed that cod-liver oil had checked the discharge, we recommended its continuance with extract of malt, nourishing animal diet, with occasional use of iodide of iron in pills; directing a wash of solution of sulphate of zinc, glycerine, and carbolic acid, with the use of Politzer's air-douche. In three weeks the hearing distance improved to fourteen-thirtieths, but no decrease in the discharge. She complained of more pain, therefore directed morphia to be added to the zinc injection; employing Clark's ear-douche, twice a day, to wash out the meatus, which duty was carefully attended to by her mother. February 28, no discharge for several days. Found the cod-liver oil was disturbing the stomach. Directed small doses of strychnia with compound syrup of hypophosphites and sherry wine. This she took for some time with great advantage.

She continued about the same during the months of March and April, at the end of which she went to Annapolis, Maryland, a place she had been accustomed to visit for several years. On her return, she had a slight chill every second day and an increase in the discharge from the ear. We at once took the hint, and gave her full doses of quinine, with entire relief to the chills and also checking the otitis. The hearing of the left ear was very much improved, and has continued so up to the present time.

We publish this case as an example of many we have had since, to show we were one of the earliest in this country to take advantage of the hint of our good friend, Weber-Liel, in the treatment of such cases. Ever since we had such success in the above and other cases, resort has always been had to the quiniæ sulphas in all obstinate cases of this disease. We prefer the original term, intermittent otitis, to the one which it has recently received by Dr. H. Hotz, of "malarial otitis," as this same term is applicable to a form of disease of the ear the result of emanations from sewer gas, foul drains, and other unsanitary conditions; the symptoms were first described by the late Dr. Cassells, of Glasgow, as follows: Severe pain in the head and ears, which were acutely inflamed, with congested membrana tympani, which were relieved by freely incising each membrana tympani, giving free exit to clear serous fluid, which continued to drain away for several days. At the end of three weeks, and without further special treatment, the cases recovered, but at the same time with the "removal of the existing cause," which was found to be escaping sewer gas from two water-closets. This condition is to be found not only in the city, but in the country, where many houses are erected without the smallest regard to the drainage of the site upon which they are built; moisture is drawn from the undrained soil. In the intermittent or "malarial otitis," Dr. Hotz dwells upon what he considers a peculiar symptom noticed, namely, a remarkable intolerance of any application in the ear, and a strange disproportion between the objective changes observed in the auditory canal and middle ear, and the degree and extent of the subjective symptoms. The patients showed great nervous prostration, and were suffering from pain in the ear and head, of such violence as we usually find associated only with acute suppurative inflammation.

Both varieties of the disease were referred by Weber-Liel to malarial neuralgia of the third branch of the fifth, or trifacial nerve, the otalgia being a malarial neuralgia pure and simple, the otitis being an inflammatory affection, the expression of a vaso-motor trophic neurosis, accompanying, or produced by, the neuralgic affection. After the irritating influence of the malarial poison in the first fever has ended in a severe paroxysm of pain, simultaneously existing in all the branches of the trifacial and neighboring nerves, the malaria is shown, for a considerable time longer, in the form of a vaso-motor neurosis, as the effect of which, there is injection of the tympanic blood-vessels and a collection of muco-purulent secretion in the tympanum.

The following are the symptoms and course of the ear disease: Generally, although not always, there has been a preceding angina or naso-pharyngeal catarrh, when, towards evening or in the night, there is a chill, perhaps so slight that it is scarcely noticed. This is followed by a feeling of fullness and roaring in the ears, and sometimes by vertigo and pressure in the head. The patient passes a restless night, with profuse perspiration, but, on the next day, is perfectly well, and the ear symptoms have passed off. Forty-eight hours or so after, there is another chill, with shooting pains in the ears, deafness, and increased subjective sounds: an examination of the ears often shows, in this stage, an exudation in the tympanum. As the stage of perspiration comes on after the chill, the patient falls asleep, to wake perfectly well, except that the subjective noises continue. If the exudation of the tympanum has ruptured through the drum-membrane, the discharge, which was perhaps profuse during the night, ceases by morning, and all pain is relieved. Tenderness of the tragus, which was marked during the attack, is also relieved. Thus the attacks continue, following the quotidian or tertian type, with intervals of perfect freedom from all general symptoms, although the local symptoms in the ears increase in severity, and the intermissions, so far as the ear is concerned, become less and less marked, till, finally, the ear symptoms are a constant irritation. Usually but one ear is affected. The mastoid cells may gradually become involved and be filled with pus. Local treatment, even paracentesis of the drum-membrane or perforation of the mastoid cells, affords only temporary relief to the constantly-recurring attacks of pain. Neither the air-douche, warm or cold applications, or morphine injections prevent the recurrence of the nightly pains. Quinine, alone, in a large dose, gives relief, and the earlier it is prescribed, the more thorough and rapid is its action. In these cases the spleen is enlarged and tender. If the disease has continued for a long time, as it sometimes does even for months, till the local changes in the ear have become thoroughly developed, the quinine, then, is of no value. In all cases of subjective noises and tympanal catarrh, dependent upon malaria, large doses of quinine diminish the noises and deafness, while, in the common forms of the disease, the same medication has the effect of increasing the symptoms very decidedly. We have seen affections of the meatus, especially furuncles, showing a decided intermittent character, and have healed them rapidly by quinine; in these cases, he thinks the disease is the expression also of a vaso-motor trophic neurosis, the result of a neurosis in the course of the trifacial nerve. In obstinate cases of malarial disease, the quinine should be taken for a long time; not, however, in frequent doses after the acute symptoms have been relieved, but three or four times in the day, and this is to be continued for some three months.

For instance, a patient suffers regularly every evening from feverish symptoms, pain in the face, teeth, and head, and especially in the region of the ear. These neuralgic symptoms, which affect only one-half of the head, are accompanied with an inflammation and discharge from the ear on the same side. After a few hours, the patient falls into a perspiration and the symptoms disappear. There is no malarial fever in the neighborhood, but the sanitary condition of the dwelling proves very unfavorable. All the symptoms improve by a change of residence on the part of the patient.

It is somewhat remarkable that sulphate of quinine has been employed successfully in almost all affections of the ear, in the prevention and relief of acute otitis externa, media, or interna, and still holds its own as the sole remedy, in the most distressing form of disease of the ear, termed "Ménière's disease," or, what is more correct, Ménière's class of symptoms, in which auditory nerve vertigo is one of the most important symptoms. We are prepared to state that we have never seen or known of a case of ear disease that was developed from quinine, either in large or small doses, and all the cases that have been reported as such, had, prior to the use of the quinine, some form of disease which may have been temporarily augmented by the stimulation of the quinine as an antiperiodic or tonic. If there is one medicine more than another that deserves our highest praise, it is quinine, which can at all times be depended upon, without fail: how helpless would the physician be, and how many thousands annually would be consigned to a miserable existence or premature graves, if it were not for its potent power! What would be our condition had we, as of old, to depend on Peruvian bark or its preparations?

It is only necessary to keep up the action of the kidneys (as quinine is not eliminated by the saliva or perspiration), and it is rapidly changed into quinidine and quinicine,—that is to say, quinine has lost its force. It appears in the urine in from thirteen to fifteen minutes after a hypodermic injection, and is reduced to impotency in half an hour, even as rapidly when given by the rectum, and from fifteen to seventeen minutes after administration by the mouth. It is a well-known power of quinine, that it can put a stop to almost all kinds of fevers, and even pus formations. It can be atomized with five hundred grains of water containing one gramme or fifteen grains of the salt in cases of naso-pharyngeal catarrh, with an antiseptic result and a sudden cessation of fever.

Often the fault is of the stomach's not being able to receive the quinine, or it is given in too large quantities. We would recommend the bromo-hydrate of quinine in all cases where there has been developed an intolerance of it or the stomach is unable to retain the drug. If combined in this way, the quinine loses all its irritating character. Quinine produces sedation, and instead of inflammation, always reduction of temperature.

On reviewing the unequivocal (so termed) cases of quinine poisoning, with amaurosis (Wecker, Gruening), we find a remarkable concurrence in their essential features. The patient, after the ingestion of a single or repeated doses of quinine in varying quantities, suddenly becomes totally blind and deaf. *While the deafness disappears within twenty-four hours*, the blindness remains, and reveals an ischæmia (or fullness) of the retinal arteries and veins *without any inflammatory* changes. The treatment: a generous diet, a recumbent position, instillations of a one per cent. solution of the sulphate of eserine, inhalation of the nitrite of amyl, and small doses of digitalis.

APPENDIX.

HYDROCHLORATE OF COCAINE AS A LOCAL ANÆSTHETIC AND ANALGETIC IN DISEASES OF THE THROAT, NOSE, AND EAR.

MATZ* published a monograph on the Erythroxylon coca, in Paris, 1868 (Die Pflanzenloffee, pp. 91–93). The latter states that cocaine has the power of impairing sensibility when locally applied, and he is entitled to having made this important discovery, but failed to make it applicable to practical medicine. Then followed the experiments of Von Anrep, Von Bebia, and others. Various theories have been proposed to explain the action of cocaine, and while certain authors, as Pflüger, attribute the anæsthetic effect to direct action of the drug on the terminal fibres of the fifth pair of nerves, others, like Eversbusch, think that the contraction of the small arteries, and the capillary anæmia which results, are probably the essential cause of the loss of sensibility.

Dr. Koller was the first true discoverer of its valuable anæsthetic properties; for even the laryngologists only limited its use to diminish the sensibility of the larynx, but not one of them discovered its power of producing anæsthesia, so that the parts could be cut and lacerated without giving pain. The original paper read by Dr. Koller, in September, 1884, was first published in *Wien. Med. Wochenschr.*, October 25, 1884, and has since been translated and republished by Dr. Knapp,† of New York. Two weeks before the original paper of Dr. Koller was published in Vienna,

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* Appendix to Turnbull's Manual of Anæsthesia, p. 9, 1885.

† Cocaine, and its Use in Ophthalmic and General Surgery. H. Knapp, M.D. New York, pp. 1–9.

American physicians were informed of its use by Dr. H. D. Noyes, and without delay tested and proved the true anæsthetic properties of the hydrochlorate of cocaine on most of the tissues of the body, more especially the mucous membranes. Having given a full *résumé*, published in 1885,* of a large number of papers in their chronological order, I propose now to give a more brief *résumé* of our present knowledge of its various uses as a remedy in affections of the throat, nose, and ear.

The hydrochlorate of cocaine as an anæsthetic and analgetic for diseases of the throat and nose, was first recommended by Jelinck (*Wiener Medicinisch. Blätter*, Nos. 39–44, 1884).

† "Cocaine may be used in the upper air-passages in the form of solutions, to be applied by means of a brush, sponge, spray, or in the form of pastils, tablets, etc. If used in solution, it ought to be suspended in camphor-water, or a slight addition of boracic or salicylic acid should be made to the aqueous or spirituous solution, because a small fungus quickly develops in the latter when there is no such addition. The originally exorbitant price of the remedy has led to trials of very weak solutions, and there can be no doubt that even two per cent. and four per cent. solutions produce a certain diminution of sensibility of the respiratory mucous membranes. The full anæsthetic and analgetic effects, however, of which the remedy is capable, will only be obtained so far as the mucous membranes of the throat and nose are concerned, if a twenty per cent. solution be used.

"The price of the drug having lately fallen very considerably, so that the question of expense has become altogether insignificant, there is no longer any use in temporizing with weaker concentrations, and the use of the full-strength solutions may be warmly recommended. It ought to be observed here that the susceptibilities of different individuals to the influence of local applications of cocaine vary just as much as the susceptibilities to the influence of other narcotics, and that now and then persons will be met with in whom a diminution only, but no complete loss of sensibility, will be obtained.

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* The New Local Anæsthetic Hydrochlorate of Cocaine, by L. Turnbull. Pp. 7, pamphlet. P. Blakiston, Son & Co., Philadelphia, 1885.

† Year Book of Treatment, 1885, pp. 286–290.

"Some constitutions, indeed, appear not to be at all susceptible to the effect of the drug, but it may fairly be stated that these cases form only rare exceptions. Children appear, on the whole, to come more quickly under the influence of the drug than adults. Complete anæsthesia is generally produced in the part painted with a twenty per cent. solution after from three to five minutes; and lasts, with gradually-decreasing intensity, on the average fifteen to twenty minutes. The anæsthetic and analgetic effect is associated with contraction of the vessels of the parts (the ischæmia is especially noticeable in the cavernous tissue of the nose), and with feelings of stiffness, heat, burning, dryness, a desire to swallow, which, in some individuals, can only with difficulty or not at all be accomplished, and with a very transitory salivation. All these sensations soon pass away. The degree of anæsthesia obtained in the different parts of the respiratory mucous membranes seems to vary somewhat; as a rule, anæsthesia is more easily produced in the palate, tonsils, and posterior wall of the pharynx, and less so in the nose and larynx. It is very important to know that the anæsthesia and analgesia are strictly limited to the part which has been in actual contact with the remedial solutions, and that there is no extension of the effect to the parts, even in the most immediate neighborhood.

"This explains why in some operations, in which it is almost impossible to touch with certainty all the parts in which the surgical interference is to take place previous to the operation, *e.g.*, in removal of nasal polypi, the effect is often smaller than in those operations in which the whole field can with certainty be painted previously, as, *e.g.*, in tonsillotomy. In cases of operative interference in either nose or throat, it will be found advisable to paint the part to be operated upon twice over with the twenty per cent. solution, at intervals of one to two minutes, and to allow, after the second application, from two to three minutes to elapse before the operation is proceeded with. In cases of lengthy operations (removal of nasal or laryngeal polypi, etc.), it may be desirable to repeat the application from time to time during the proceedings.

"Coming now to the various uses of cocaine in the upper air-passages, I think it right to mention, in a passing manner, not only its strictly therapeutical but also its diagnostic importance. The application of cocaine to the palate, uvula, and posterior walls of the pharynx greatly facilitates laryngoscopic and posterior rhinoscopic examination in many hypersensitive persons by diminishing, or even temporarily abolishing, tactile hypersensibility. It ought not to be forgotten, however, that the difficulties encountered in the laryngoscopic and rhinoscopic examinations of some persons may not exclusively depend upon the local hypersensibility of their fauces, but more upon their nervous temperament. In order to prevent disappointment and depreciation of a most valuable remedy, it ought to be known that in such cases local applications can be of very limited, if of any value.

"The different uses of cocaine in the respiratory passages have been so well and concisely put together by L. A. Dessar ('Cocaine und seine Anwendung im Larynx, Pharynx, und in der Nase,' Inaugural Dissertation, Würzburg, 1885), that I cannot do better than translate his summary. He says solutions of cocaine secure,—

"1. Diminution of tactile sensibility. This is useful—

"(*a*) To facilitate laryngoscopic examination in cases of hyperæsthesia by abolition of reflex phenomena.

"(*b*) In posterior rhinoscopy.

"(*c*) To abolish the augmented sensibility in cases of swelling of the nasal mucous membrane.

"2. Diminution of dolorous sensibility.

"(*a*) In divers examinations. } Executed in any part of the
"(*b*) In operations. } pharynx, larynx, and nose.

"3. Abolition of dysphagia in cases of stenosis, produced by tumors, of phthisis (viz., pharyngeal and laryngeal), syphilis (viz., pharyngeal and laryngeal), perichondritis (viz., laryngeal), tonsillitis.

"4. Ischæmia of much-injected mucous membranes.

"5. Diminution of profuse hemorrhages.

"6. A certain diagnosis in cases of nasal reflex neurosis (asthma, different forms of neuralgia, hay-fever, epilepsy).

"During a year's very frequent use of cocaine in different forms and in different diseases, I have found it most useful (1) in tonsillitis, in which it often abolishes for a time, as if by magic, the dysphagia, and enables the poor patients, who have not been able to swallow even fluids for days, to comfortably enjoy a good draught of milk or beef-tea; (2) in tonsillotomy, which operation is really rendered perfectly painless by the previously twice-repeated application of a twenty per cent. solution to the tonsils and their whole neighborhood; (3) in uvulotomy; (4) in the removal of laryngeal growths; (5) in cauterizing the nasal mucous membrane with the galvano-cautery; (6) in diminishing pharyngeal hyper-irritability for purposes of laryngeal and rhinoscopic examination; (7) in acute coryza of adults and in infants; (8) in laryngeal phthisis. I have also seen very good effects from the use of pastils (cocaine hydrochlor. gr. ⅛ or more, pro pastilleo) in cases of dysphagia due to laryngeal phthisis and laryngeal epithelioma. My results during the past year have been less satisfactory in hay-fever; the remedy, whether applied in the form of solution, spray, or tabloids, has had but a very temporary, if any effect, in those cases which have come under my observation. In cases of nasal polypi, the effects have been very varying; some patients professed that the previous application of the remedy relieved the small pain caused by the galvano-caustic removal of the growths; others stated that they found no difference. The probable explanation of this discrepancy of statements has already been given. On the whole, there can be no doubt that the introduction of cocaine must be considered as the greatest event in the therapeutics of the upper air-passages for some time past."

COCAINE IN DISEASES OF THE EAR.

As cocaine has been found so valuable in diseases of the throat and nose, it became of great importance to the otologist. The throat and nose bear an important relation to the ear, and often by relieving or curing certain affections of the throat and nose, we can succeed in the cure of the disease of the ear.

Catheterization of the Eustachian tube through the nose is greatly facilitated by previously applying cocaine to the nasal passages and to the pharyngeal orifice of the tube. This can be done with an atomizer, or a brush, or a cotton pad at the end of a probe. The mucous membrane becomes insensible and thin; the catheter glides over the parts without pain, and is introduced more readily because of the dilation of the nasal passages. This remedy will render direct catheterization possible in certain cases in which otherwise it could only be effected through the mouth or the nostril of the other side. Whether these modes are so efficient as the introduction of the catheter through the nostril of the same side I know not, but I do know that changing the classical bend of the catheter by making it straighter in order to pass it through a narrow or crooked nasal passage, renders catheterization both for purposes of inflation and injection proportionately efficient. It would be too troublesome had we to apply cocaine often in the same case; fortunately this is not necessary, for when the remedy has helped the patient over the discomfort of the first trials, the repeated introduction and treatment have made the manipulation easy. Injections of cocaine into the Eustachian tube will, by their contracting influence on the blood-vessels, dilate the calibre of the canal, facilitate inflation and injection of liquids into the tube and the tympanic cavity.

It is of advantage though, and it has been tried, to inject one or several drops of cocaine, warm, through the Eustachian tube into the drum-cavity for severe earache of inflammatory origin. It can also be injected through the drumhead with a hypodermic syringe.

Instillations of cocaine into the external ear canal, in cases of neuralgic earache, have been found useful in certain conditions.

On the benefit derived from inflammatory earache, Dr. F. P. Kinnicutt writes as follows: "I have very lately used a four per cent. watery solution in three cases of acute earache in children. By means of a speculum and dropper, I have applied one or two minims directly to the drum-membrane, in each case with complete and immediate relief; there was no recurrence of the pain."

In tinnitis aurium I have found improvement from instillations from cocaine.

In all cases that require manipulations, or the applications of remedies or incisions, scraping, torsion, avulsion, ecrasement, etc., in the tympanic cavity, when the drumhead is perforated, or in ulcers of the ear canal and the auricle, local anæsthesia can be easily and satisfactorily effected by instillations of hydrochlorate of cocaine. The tissue-contracting and hæmostatic effect of the drug will greatly add to its value in all operations of the middle ear. These operations are particularly difficult on account of the narrowness of the ear canal and its obstruction by the slightest hemorrhage. In prolonged operations—for instance, the removal of multiple polypi—the instillations should be continued during the operation. I have derived great advantage from this procedure in several operations.

Also in cases of acute purulent otitis, accompanied by intense pain, where the tenderness of the swollen walls of the meatus made cleansing both by syringing and the dry method excessively distressing to the patient, I have noticed great benefit from cocaine instillations. The manipulations were made easy, the cleansing could be thoroughly done, and the application of remedies—boracic acid and weak solutions of corrosive sublimate—cause no annoyance. This treatment, because of its painlessness, was regularly carried out, and the recovery was smooth and speedy.

The application of painful remedies in cases of chronic purulent otitis—for instance, nitrate of silver, alcohol, etc. —can be done after cocainization with great or entire relief from pain.

The analgetic effect of cocaine has been noticed by other aurists and myself, in cases of earache, when the perforation of the drumhead gives the remedy access to the middle ear.

Perforation of the membrana tympani can be performed with entire absence of pain, if the solution is strong, and used warm. In my experience, instillation of cocaine upon the inflamed, non-perforated drumhead diminishes its sensitiveness to the touch of a probe, and an incision in these cases is almost painless.

Operations on the walls of the ear canal, the auricle, and its surroundings, such as the removal of tumors, incisions into the skin, etc., can be rendered painless by subcutaneous injections of cocaine, if the transient freezing with ether or rhigolene spray is not preferred. A few days ago I enucleated a cystic tumor, the size of a cherry, from the posterior surface of the lobule. The lobule and the tumor were held between the branches of an eyelid clamp. Two drops of a twenty per cent. solution of cocaine were injected under the posterior side of the tumor, and two under the anterior. The tumor was shelled out entirely without pain, and without loss of blood.

COCAINE IN OPERATIONS OF THE EAR.*

Kretschmann (*Arch. f. Ohrenheilk.*, xxii. p. 243) finds that in operations on the membrana tympani, cocaine is not so certain an anesthetic, but in operations of the mucous membrane it has a marked effect in alleviating pain.

Kirchner (*Deutsche Med. Woch.*, No. 4, 1885) also finds that a twenty per cent. solution is required to produce any effect in operations of the membrana tympani. Zanfal (*Präger Med. Woch.*, November 7, 1885) has obtained similar results.

Cocaine is, in my experience, a very satisfactory anesthetic in operations of the ear. In the removal of large and painful polypi it is useful, and in smaller growths, especially those near the membrana tympani, a twenty per cent. solution of this drug has invariably proved valuable. The part to be operated on should first be carefully wiped dry with cotton wool, to remove any collection of pus; the solution of cocaine should then be painted on with a camel's-hair brush, and allowed to remain for at least five minutes, before any operative measures are adopted. The weak solutions of cocaine recommended by some surgeons are all but useless.

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* Field on Diseases of the Ear. The Year Book of Treatment, p. 276 (1885).

Dr. H. G. Sherman (*New York Med. Record*, November 15, 1884) has twice instilled a few drops of a four per cent. solution into the ear in tinnitus aurium, consequent upon otitis media, with the result of lessening both tinnitus and deafness.*

EXPERIMENTS WITH SHEPPARD'S SOLUTION OF PEROXIDE OF HYDROGEN AND BORACIC ACID, IN CHRONIC PURULENT INFLAMMATION OF THE MIDDLE EAR.

CASE I.—I. W., aged eight years, Philadelphia; otitis media purulenta; discharge from the ear, with perforation, following an attack of scarlet fever, which he had in April, 1885. He had been treated, by the family physician, with careful syringing and carbolic acid. The discharge ceased for a time, but, in September, returned, when the case was sent to me. The patient was feeble, nervous, and very much broken down. We stopped the syringing, placed him upon tonics and alteratives, and applied ointment of hydr. ox. flav. in vaseline, to the nose and ear, after cleansing the latter with absorbent cotton.

October 15th. Still a watery discharge, and the perforation not healing. Applied the solution of peroxide of hydrogen, after cleansing carefully; at the same time, opened the Eustachian tube. No pain, no discomfort. This case did not get well until September, 1886, when the perforation closed over.

CASE II.—H. G., aged sixteen, Philadelphia. Has had a purulent discharge for years, with entire loss of both membrana tympani, following malignant scarlet fever. He had been treated by family physician for a long period without improvement,—came under our care, and, soon after, discharge was much improved, and by the aid of a "cylinder-form" piece of lint he was able to pursue his studies at the Philadelphia High School. Recently (1885) the discharge returned with great persistence, and, in spite of all ordinary remedies, was very annoying. On the 1st of October, 1885, we made a free application of the peroxide of hydrogen, after carefully wiping the ear; this caused bubbling and removal of pus to the surface, and opened the Eustachian tube.

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* See Cases of Tinnitus Relieved. Turnbull on the New Anæsthetic in p. 36, *op. cit.*, also pp. 38 to 45.

October 19th. He states that "the discharge still runs, but has become much thinner in consistency." A second application of the peroxide of hydrogen caused great effervescence, the bubbles coming outside of the ear with a peculiar noise, and the fluid passing into the Eustachian tube.

October 26th. Discharge much reduced; still, on making an application, there were the usual bubbles, mixed with discharged pus, but smaller in quantity.

November 7th. Very little effervescence when the solution was applied. Patient states that he feels his ear to be "open and free;" is able to hear distinctly.

November 22d. Very little discharge, feeling that his ear is open.

January 20th, 1886. No discharge. Patient has had his Eustachian tube open for one month. Exposed himself to cold, and it caused swelling of the tube, which filled with pus. Opened by the same means, requiring twice the quantity used before.

Several months later, the patient stated that he had had no discharge for several months, and his Eustachian tube had been open until within a few days, when it closed. An application opened the tube, and up to June, 1886, has had no return.

CASE III.—Miss M. C., aged sixteen, Tom's River, Md. Otitis media purulenta, with perforation; discharge from one ear, but both ears affected.

October 6th. Applied the sol. peroxide hydrogen. There was free effervescence. Discharge was effectually stopped, and in twelve months was entirely well; no discharges; and masses of hypertrophic tissue removed by snare from the vicinity of the Eustachian tube, with great improvement of voice and hearing.

CASE IV.—Rev. Dr. C., aged fifty years. Has suppurating ear with perforation, and has been using boracic acid at the suggestion of his doctor, with but little effect. We applied sol. perox. hydr. The discharge was greatly lessened. He made but one more visit and stated that he had experienced great relief.

Case V.—November 16th, 1885. Thomas W. D., aged eighteen. Has suffered from otitis media purulenta of both ears, following an attack of scarlet fever, which he had in childhood. He has experienced recent relapse of the ear-trouble, with increased deafness and discharge. He has been under two prominent aurists, who promised to cure him, but no improvement followed their treatment. On examination, both membrana tympani were found to be destroyed, and there were masses of granulations on the promontory, with discharge of pus. He also suffers from ozæna. We ordered him a sol. of perox. hydr. to be applied to ear, and powdered boracic acid to nose and throat.

November 22d. Returned. No discharge; very much improved in his hearing. Nose and throat better. There continued to be steady improvement. The discharge entirely ceased, and the patient's hearing was much improved.

Case VI.—November 23d, 1885. J. E. T., aged fourteen. Has suffered from childhood with a discharge from his left ear, following scarlet fever. He has been under treatment for a long time, with but little relief. Has had, within four days, an acute discharge, followed by severe pain; relieved, in part, by a hot application of laudanum and sweet oil. There is not a remnant of membrana tympani left; great inflammation and swelling in front of the ear. We applied a sol. of cocaine and sol. atropia sulph. until pain was relieved; then used sol. perox. hydrogen and the application of pulv. boracic acid to nose and throat,—directed its application ten days. Pain and discharge entirely ceased, and there has been no return of either.

Case VII.—December 9th, 1885. B. S. Catarrhal otorrhœa, with slight perforation,—discharge from the ear, the result of cold in the head. Employed perox. hydrogen.

December 16th. Discharge almost gone.

December 23d. Still discharging.

January 18th. The patient's mother reports no discharge.

February 17th. No discharge.

April 14th. All discharge stopped. Introduced an artificial drum-membrane.

May 31st. Part of the artificial drum-membrane came away, and part remained in place. We removed the artificial membrane, and discharged the patient well, with the membrane healed.

Case VIII.—Stella D., aged sixteen. December 19th, 1885. Attacked February, 1883, with scarlet fever, followed by perforation of the drum-membrane of right ear; was under treatment in 1884, and discharged almost cured.

On December 5th, 1885, the patient contracted "cold," and there began to be a free discharge of yellowish-green pus from right ear. The mother kept the ear clean and employed the boracic acid treatment, but discharge increased. She also attempted to keep the Eustachian tube free, but was not successful. On cleaning the ear carefully, we found the tympanum filled up with granulations. We therefore applied equal parts of tinct. ferri hydrochlor. and glycerine. A sol. of peroxide of hydrogen was also directed, and the child was taught to force air into the Eustachian tube by the Valselva method.

December 23d. Still discharges, and there is some swelling of the glands. We ordered iodine to be used internally and externally.

January 18th. Ear discharge has ceased, but the nose continues to discharge, and there is hypertrophy of the mucous membrane. We applied "Mitchell's ear-cones," containing iodoform, 1 gr., to each of the nostrils, and painted the glands of the throat with tinct. iodine.

January 30th. Returned. The discharge from nose is much improved. We used cones of iodoform, and cleansed with sol. perox. hydrogen.

February 5th. Again returned. The discharge was so free that we washed the ear, and found granulations at the bottom of the meatus, to which we applied the sulphate of copper in pure powder, and directed that boracic acid be carefully packed into the ear.

March 3d. Returned. We had to pack the ear again with equal parts of boracic acid and powdered alum.

April 23d. No discharge; no pain; improvement in hearing.

These few cases noted, with many others which were treated, will, we think, prove the value of the fifty per cent. solution, alone or diluted, of the peroxide of hydrogen as a cleansing agent, especially in opening and keeping open the Eustachian tube in chronic cases, and with the use of the boracic acid, carefully packed, gives, we think, very good results. In two cases recently treated with this solution, where there was but a rim of membrana tympani, it gave the patient pain; one was an adult, and the other a young lad. I therefore reduced the solution one-half with hot water before introducing it.

OPERATION FOR THE RELIEF OF CHRONIC PURULENT INFLAMMATION OF THE MIDDLE EAR.

Dr. Sexton has recently suggested an operation for the relief of chronic purulent inflammation of the middle ear. He claims that the conducting mechanism in these cases has become useless for the performance of its functions; acts as much as would a foreign body; and prevents the proper drainage of the parts. The operation is described as follows: "The first step of the procedure is to separate the membrana flaccida from the edge of the auditory plate, and to remove any portion of the membrana vibrans adherent to the auditory ring. If the malleus and incus remain *in situ*, it is well to divide the tendon of the tensor tympani muscle when present, where it leaves the handle, just behind the short process and below the chorda-tympani. The chorda-tympani, when remaining, is then divided where it enters the tympanum at the pyramid, and also at its exit into the canal of Huguier. The long process of the malleus, being also received into the glenoid fissure by means of this short oblique canal, along with the chorda, may be more or less detached at the same time. The detached tissues and ossicles should now be removed with the forceps. It will frequently be found that the incus, though displaced, still remains. It may be removed with the 'attic scraper,' which is to be introduced from below and passed up along the inner wall of the tympanum, when the distal end may be carried over the incus or malleus, if the latter bone remain, and, by traction, the ossicles may be tached. Polypoid masses, granulation-tissue, and the products of inflammation may now be removed with the cutting curette or cutting forceps, and the parts dressed with a four per cent. solution of cocaine. There is usually free bleeding during the operation, often sufficient to protract it and increase its difficulties. In order to avoid the danger of using an ordinary lamp in connection with the administration of ether, an electric light has been used. . . . The drum cavity should be kept well cleaned, and light dressings of boracic acid applied until healing takes place. Salicylic acid powder may be applied as freely as it will be borne. In some cases, irritation at first is succeeded by tolerance. It may be kept up until the parts cease to discharge. In the cure resulting from this treatment a dermic transformation of the tympanum takes place; but mucus may at times gain admission from the Eustachian tube. Where the incudo-stapedial connection remains, the operation may still be performed, unless a considerable portion of the membrana-vibrans is present."*

Dr. Sexton has, heretofore, been a great advocate of minute doses and mild measures. In this operation, however, he has gone to the other extreme; for we consider the operation to be an heroic one, and full of great risk to the patient's life. Indeed, this calamity is all the more to be feared, inasmuch as many cases of chronic purulent otitis are to be found among feeble individuals who are scrofulous or tubercular. Even where such diatheses do not exist, there is still the danger, frequently attending operations of this kind, of causing an extension of the disease into the cerebellar sinuses and even the cerebrum. Again, the use of powder, especially the salicylic acid, is to be avoided. The latter drug, by its stimulating nature, is apt to cause irritation and an increase of the granulations. We have cured the same disease in this vicinity by the careful use of a solution of the peroxide of hydrogen, which we introduced warm, by means of a spray, the rubber tips of the instrument being coated with platinum, as manufactured for us by the Davidson Rubber Company of Boston, Mass.

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* American Journal of the Medical Sciences, October, 1886, page 570.

DIPHTHERITIC INFLAMMATION OF THE MUCOUS MEMBRANE OF THE NOSE, PHARYNX, AND EUSTACHIAN TUBES CAUSING DEAFNESS.

In May, 1886, a distinguished general surgeon of Wilkesbarre, Pa., brought an interesting little patient, who was deaf, Helen M. D., aged six years, to see what could be done for her. When examined, her hearing was found to be only four inches for a watch-clock of twenty-five feet; this in her best ear, the left, while in the right this same watch-clock could not be heard on contact.

The little one was very bright and intelligent, and had to be examined by turning the eyes away, as she was quick to notice the motion of the lips. The tuning-fork was heard in air and on the bones of the head, but best in air.

The membranes of both ears were retracted, and the Eustachian tubes with difficulty opened. She had, as with most of those cases, evidence of the severe diphtheritic inflammation, which manifested itself by a sclerosis of the naso-pharyngeal mucous membrane, with a disposition upon the part of the patient to frequently draw inwards the secretions of the nostrils. Two years ago she had a severe attack of diphtheria, since then has been deaf absolutely in the right ear, less so in the left. There was, according to the father, no hereditation in the family.

Her constitution had been good, and her general health fair. During these two years everything had been done in the way of general and local treatment without benefit. She was then sent to a gentleman for special treatment, by means of electricity, first for one month, then again for three months. She seemed to improve slightly, for a time, but, as soon as electrical treatment ceased, she relapsed. This case is brought forward and given in detail as an example of many cases which come too late to the specialist in ear diseases to be of but slight benefit to the patient. We are of the opinion that this is owing to a want of knowledge on the part of the general practitioner of the true pathology of this insidious disease. Having had the opportunity of seeing and treating a number of cases of acute diphtheria causing deafness, which were relieved by general and local treatment, we would therefore impress upon the medical man the great importance of treating the deposit, while recent, by means of the local application of the chlorides of zinc and iron, the use of the spray of lime-water, and, above all, the removal from the Eustachian tube and middle ear, by the Eustachian catheter or Politzer's air-douche, of the inflammatory product, or reduction by iodine of the enlarged acinous glands, which are found to produce obstruction. In some cases there is a paresis of the tensor palati and levator palati muscles, and the cilia cease to move the mucus into the pharynx. One acute case, under our care, was very much improved by the use of the galvanic current locally, and strychnia internally.

Pathology.—According to the observations and post-mortem examinations of Schwartze* and Wendt,† they only found purulent and putrid catarrh in the middle ear, when there was severe diphtheritic inflammation of the mucous membrane of the nose and pharynx. Wreden,‡ on the other hand, reports that in St. Petersburg he has frequently observed, during life, a diphtheritic inflammation of the middle ear in the course of scarlet fever, with diphtheritis of the nose and pharynx, occurring in children from four to fourteen years of age.

In confirmation, Dr. C. E. Billington,§ of New York, has stated that the ear had not, in his experience in a large number of cases, been affected in diphtheria, except in such cases as were complicated with scarlatina. This is no doubt true, but we have seen the ear affected with true diphtheria, no scarlet fever, by continuity with the naso-pharyngeal space, followed by deafness, causing swelling and inflammation of the Eustachian tube, and the deposit of a true croupous membrane in the middle ear. These facts have been confirmed likewise by Krupper‖ and Gottstein, who report cases, and Blau,¶ of Berlin, who reports a case of diphtheritic parotitis occurring after an attack of scarlet fever. We should therefore be on our guard, and watch the ear in either class of cases, and be ready to ward off any evidence of disease which may be developed.

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* Arch. für Ohrenheilkunde, i. s. 202. † Arch. für Heilkunde, ix. s. 260.

‡ Monatschrift für Ohrenheilkunde, 1868, No. x.

§ Trans. N. Y. Academy of Medicine.

‖ Arch. für Ohrenheilkunde, Bd. xi. p. 19. ¶ Berlin. Wochenschrift.

ARTIFICIAL MEMBRANA TYMPANI.*

PROF. GRUBER, of Vienna, as early as 1877 proposed and used the application to the perforation of the membrana tympani of linen patches and disks of adhesive plaster (lead plaster), English. Dr. Blake, of Boston, in 1876, recommended disks of sized paper, wet with water, over the perforation. The objection to these latter was their rapid removal from the ear, or curling up and not protecting the membrane.†

The frequent *inflammation of the ear and otalgia* caused by the presence of a *decayed tooth* or sore on the tongue was explained by the fact that fibrillæ belonging to the vaso-motor system of nerves mingled with those of the cerebro-spinal system; the former set of fibrillæ being brought into reflex relationship with the nervi vasorum distributed on the arteries of the part reflexly affected by means of the sympathetic ganglia, in which two sets of fibres communicate. In this way it was shown that distinct channels of communication existed between the vessel nerves which regulate the supply of blood to the ear and the otic ganglion, while branches of the fifth nerve connected the carious tooth, and ulcers on the tongue also communicate with this ganglion. Morbid impressions affecting the latter would influence the former, and thereby produce vascular distention of the drumhead and contiguous regions, producing a veritable hyperæmia of these parts, as a consequence of which pain and inflammation were referred. Dr. Woakes explained what may be a frequent cause of spasmodic croup: a communication existing between the nervi vasorum of the vessels of the larynx and the auriculo-pneumogastric nerve supplying the meatus. Cold draughts of air falling upon the ear would through sympathy be the cause of spasmodic croup.

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* See also chapter xv., page 293, and chapter xxi., page 489.

† On inflammation of the ear caused by decayed teeth, see page 307.

Laryngitis may thus occur from the presence of a foreign body in the meatus.

SIEGLE'S APPLICATIONS.*

The following is an improvement of Siegle's apparatus: Obtain a piece of india-rubber like those on the atropine dropper, and fit it upon the specular part, and it makes a soft, air-tight plug, and then we can make a vacuum, in a meatus of any size, without pain to the patient. By successive blowing and suction make a sunken or flabby membrane flap backwards and forwards. It is useful not only in diagnosis for the condition of the tensor tympani muscle, but also to break up adhesions. It will show if tinnitus be caused by intra-tympanal pressure. Then the use of the catheter or Politzer air-douche will diagnose tubal catarrh as a cause; by exclusion we can thus judge pretty well of the cause of the tinnitus. If the adhesions are very firm, resort is had to a small syringe or metal exhauster attached to the elastic tube by removing the mouth-piece.

THE BEST MEANS OF ILLUMINATING THE EAR, NOSE, THROAT, AND EYE.

An efficient means for illuminating the deep-seated portions of the ear is a desideratum yet to be obtained. Polarized light has been employed by Drs. Hagen and Stimmel, and they state† that it was possible to determine the presence of adhesions, and pseudo-ligaments in the tympanic cavity with opacities of the membrana tympani, etc., not seen by the aid of the mirror or Tobold's lens, or the argand gas-burner. As yet no one has confirmed these observations, nor has there been any good description of illuminating apparatus published in any of the recent works on the ear except that of M. Miot.*

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* See page 84.

† See Report on the Progress of Otology. C. J. Blake, M.D., Boston.

The oxyhydrogen light has been used for the same purpose, and is obtained by means of an argand burner into which come separately the oxygen and hydrogen gas. To make it less expensive and more intense, Debray has constructed an apparatus composed of two pipes, one of which conducts hydrogen and the other oxygen to the burner, and has arranged a pencil of magnesium, zincone, or strontium, so that it may be placed at the centre of the flame.

The magnesium light has also been used with the lamp of Solomon. It has been found to have much brilliancy, but gives too much vapor, and requires the use of a clock movement to allow the magnesium wire (of ⅓ to ¼ millimetre of diameter) to spread to a degree that it may burn.

The carburetted gas-light is almost in general use in all important cities. This can be utilized for rhinoscopy; it gives a good light, if there is a uniform pressure, when we use the argand burner or a double current of air. We should employ a gas rich in carburetted hydrogen, or make the gas pass over the sponges saturated with carburetted liquid like naphtha or in a white carbon (alba carbon) apparatus.

Vegetable and mineral oil lamps.—These lamps are much used. Among the vegetable oil lamps, the Carcel lamp and the lamps with moderators are the best, because the liquid comes in a sufficient quantity to the wick, which is always kept at a temperature high enough not to blacken.

The French lamp of Marnet, or one of the same system, is the best of the petroleum-burners; it gives a much better light than the others, because of the cylindrical wick.

The lamps should have burners of 25 millimetre diameter for vegetable oil and 20 millimetre for soléine and petroleum. Lamps have also been used with a burner in the form of a ring of 6 centimetre diameter, and pierced with numerous holes, through which are passed small wicks. They are maintained by petroleum, and give a light superior to that of all other lamps.

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* Traité Théorique et Pratique des Maladies de l'Oreille et du Nez. Par M. Miot, Paris, 1884.

The chimneys of certain mineral oil lamps, as those of petroleum, for example, should have an annular contraction directly above the level of the wick, or with a wide chimney having a circular metal disc within the flame, in order that the vapors which disengage themselves from the wick meet an obstacle and turn towards the central parts of the flame, where they are consumed, giving additional light.

The oils used to maintain the lamps are vegetable or mineral. The first are divided into essential and fixed oils; the former gives a very effulgent flame in order to produce a fine light. Gasoline however, must be excepted. This is a mixture of the essence of turpentine and alcohol, a good illuminating oil, but very inflammable, and therefore dangerous. The fixed oils are used everywhere, but the refined oil of rape-seed is to be preferred to that of nuts, or hempseed, etc. The mineral oils most preferred are those of refined petroleum in this country, the essence of the same name, "soléine," in France, or head-light oil, or Pratt's astral oil, which we use here, and should have a specific gravity of 795° and a fire heat not below 150°. The oil of refined petroleum should not give off inflammable vapors, diffuse no odors (unless the wick is too low), like the essence of turpentine, which has an illuminating power superior to that of the fixed oils, and should be preferred to them. The duplex, or Rochester lamp,* gives a better light than the ordinary petroleum lamp under the same conditions, and appears superior to it. We concentrate the light of these lamps for throat examinations by means of a refracting apparatus or by reflectors. Among the first we notice the convex lens held in the hand, or mounted on a foot, or fixed to the lamp with a collar (Moura and Mandi, etc.), or confined to an apparatus analogous to that of Von Troltsch or Kramer for the ear (Kristeller, Tobold, Bruns, etc.). The reflectors or concave mirrors are much larger than those for otoscopy; their diameter is 9 to 10 centimetres, and their focus about from 22 to 25 centimetres. They are held by the hand or fixed to a mounting or attached with a band to the forehead.

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* One inventor has fitted the connection between the burner and the lamp with a cork lining, which, besides making an air-tight joint, acts as a non-conductor of heat, and keeps the *oil* and the *reservoir* containing it perfectly cool.

Advantages and inconveniences of different illuminating apparatuses mentioned above.—The electric light illuminates perfectly the back of the throat, and does not modify the color of the tissues; but the necessity of using the pile or dynamo-electric machine makes it very inconvenient. It will only be truly generally employed when we will be enabled to use it like gas, without pre-occupying some generating apparatus.

The oxyhydrogen-light and the magnesium-light will probably always be very much restricted in use, because of the difficulty of procuring the necessary gas, of the inutility of so intense a light, and of divers inconveniences they present.

The gas-light gives good illumination if the conditions before enumerated are fulfilled. But Miot prefers the light of petroleum or soléine, and we the head-light or Pratt's astral oil.

As to the refracting apparatus, they concentrate the light well, but they are very expensive, and for ordinary exploration or operation are less easy to handle than the concave mirror held in the hand or fixed to a frontal band.

Electricity—Electric and other forms of light for illuminating.—Electricity is the same no matter by what means it is set in active motion.

The first form of electricity employed in medicine was "frictional," now termed "static" or Franklinism, and it was developed by rubbing amber, and subsequently glass. The latter was found to produce all the various manifestations, as attracting light bodies, causing sparks, and, if the glass had a metallic coating on each side, as, for instance, a glass jar, this could be charged and the electricity retained until it was desirable to use it, when, by uniting the two surfaces, a spark would pass, and if the human body was part of the circuit it received a shock. This discharge was employed to change or alter various portions of the body, especially the skin and nervous system.

The following were my conclusions in regard to this form of electricity originally published in 1872 in this work:*

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* See page 373.

"Owing to its being so easily dissipated, its too rapid and incontinuous action, and being confined with great difficulty to conductors, its employment is rendered rare as a therapeutic agent." A great change has taken place in our use of "static" electricity, by coating with shellac or rubber the glass plate or cylinder of the machine, and connecting the machine by brass chains to the earth, and having moist electrodes and a switch which will furnish not only a direct but an indirect current.

The second form of electricity discovered was galvanism, or electricity developed by the contact of metals or chemical action, which was discovered by Galvani, a Professor of Anatomy, at Bologna, who also demonstrated that the contact of the nerves of the frog with an electric current produced muscular contraction.

The therapeutic properties of the galvanic current are, as a rule, in diseases of the ear, more potent in effecting a cure than the induced current. One of the chief advantages of the galvanic current is that, in a painless way, and with but slight shock, considering the enormous resistance of the body to the electric current, we can introduce into the system a large amount of electricity, which is often indispensable. With this galvanic or constant current we excite the nerves of sense, the skin, and induce absorption by chemical decomposition and blood coagulation. The interrupted current excites the muscles, the sensory or motor nerves, or affects certain organs supplied by the sympathetic.

It is a well recognized fact that it is extremely difficult to produce sound sensation in the ear by means of the galvanic current, and yet we know from numerous experiments extending over many years, that the auditory nerve can be excited by this form of electricity. We have been able by means of a moist conductor in the ear, and another on the mastoid process, to produce the same sounds with "static" electricity, now termed "Franklinism."

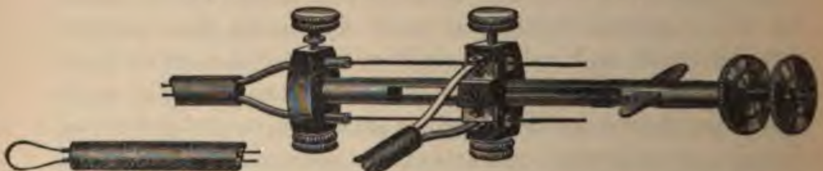
This latter form of electricity will also produce flashes of light when applied to the eye by the eye-cup, affecting the optic nerve. If in the ear, it causes muscular contraction of the tensor and laxator muscles. The mode by which the writer employs electricity to the ear is by way of the Eustachian tube, and by the external auditory canal, or by moist electrodes on the surface of the body. A hard rubber or soft silver Eustachian catheter is introduced through the nose into the pharyngeal orifice of the tube, then inside of this a fine French silk catheter, in which a platinum wire is placed with a small brass bulb on the end, so as not to injure the soft parts. With this apparatus connected with the battery, we can produce, with the positive pole touching the wire, while the patient retains the negative pole or conductor, and thereby controls the pain, by breaking the connection at any moment, electrization of the auditory nerve. In thickening or disease of the tubal muscles, we find the best results from the use of the interrupted current of the static or dynamic machine, by moist sponges to the ear, or through the Eustachian tube by means of the rheophore. (See page 378.)

The application of any of the forms of electricity should not be employed to the ear more frequently than twice or thrice a week, and only for eight or ten minutes on each occasion. We must never employ a current so strong as to excite more than a decided tingling sensation, or a slight metallic taste or muscular contraction, the sounds of which, if the current is broken rapidly, resemble the beating of a fly's wings between the window-pane and the curtain. In the static machine, we produce this tingling sensation by keeping the discharging rods near together, and the farther they are removed the more decided is the tingling, until we have produced long sparks or a continuous flame of light, when very active muscular contraction takes place.

The *galvanic cautery* requires great care in its use in the ear and nose, on account of the ease of injuring healthy tissue in cavities so limited in size. The electrode should be very slender and well insulated with asbestos or rubber, so that when introduced into the ear, nasal passages, or throat, it should take up very little space, and the burners should be composed of platinum. A good light should be thrown into the parts, by the incandescent electric light, Tobold's lamp, or argand gas-burner, with forehead mirror. (See Fig. 108.)

" A great advantage of the use of the galvano-cautery is its application to the principle of the snare. It is well known that a loop of wire which is steadily narrowed has great power in severing the attachment of tumors and other outgrowths. When of a large size, they may be sufficiently powerful to pass through bony structures, as well as the softer parts of the body. The principle of the snare has been employed both in the throat, the ear, and the nose; but when my attention was first directed to this subject the forms available were too large and heavy for the delicacy of manipulation demanded in removing small tumors lodged in the narrower recesses of the nose. Moreover, no snare that I could then find would permit the galvanic current to pass through the loop at the time it was being narrowed. I was led, therefore, to inquire into the practicability of an instrument which would be at once light, of small size, and yet sufficiently powerful to remove that class of hypertrophied tissues and polypoid growths which are of such frequent occurrence in the nasal chambers. The instrument shown combines these qualifications, and satisfactorily performs the service for which it was designed. The only feature of an essential character which may be said to be novel is the fact that the platinum wire (3) forming the snare is covered with a uniform coat of copper, except alone the portion forming the loop, which is bare. As a consequence of this arrangement the current of electricity from the battery is conducted through a double canula (1) by means of the copper. The advantages of the electrical snare over others in use are: the facility with which the small loop can be carried against a small growth not ex-

Fig. 108.—The Electro-Cautery and Snare.*



1, connecting cords of the battery; 2, a canula coated with vulcanite; 3, a platinum loop; 4, a vulcanite carriage bearing metallic tubes occupied by the platinum wire; 5, an aluminium slotted shaft; 6, a movable screw-head; 7, a portion of the screw; 8, a milled fixed screw-head.

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* Manufactured by the White Dental Company.

ceeding the size of a grain of wheat or corn; the ability to grasp readily the pedicle, and by a few turns of the movable nut to cut its way into the tumor, when by an application of the current, all points of resistance can be easily overcome. The most vascular structures may be freely entered and divided. If a growth be hard, resilient, or of a size so large as not to enable the loop to be readily engaged upon its base, the wire is simply held against the side of the growth, when the current will gradually burn its way into the mass to any extent which may be determined by the operator. When it is in this way received within the growth, the loop may, as before, be narrowed and a portion of it removed."—*Extract from lecture on "Electricity in Medicine," at the International Electrical Exhibition, by Harrison Allen, M.D.*

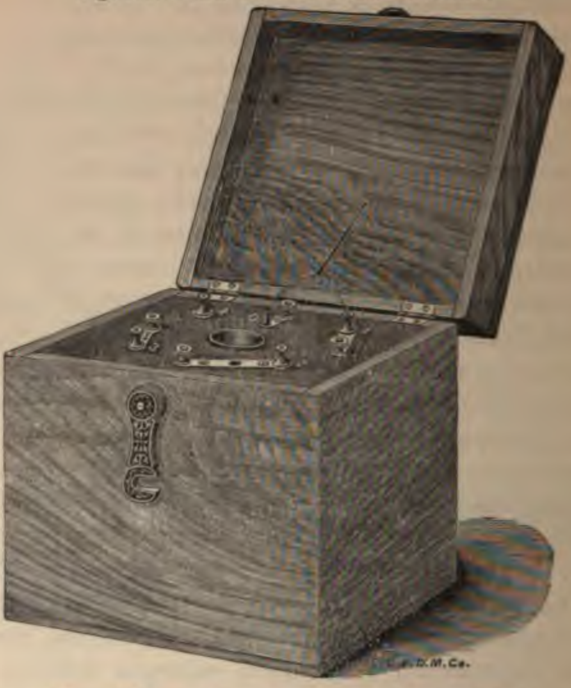
In using the snare, it should be introduced cold through an insulating speculum. Two seconds is the longest time for each application, and not more than two applications should be made at one sitting. Be sure that all moisture is removed before making your application. As the burner cools, withdraw the instrument slowly, so as not to let the patient see it red-hot. This method is applied for the removal of fibrous polypi near the Eustachian tube or upper part of the nasal cavity, hypertrophied mucous membrane in the ear, caries, adenoid vegetations, very much enlarged follicles in the pharynx and tonsillar region, not removable by the improved snare of Dr. Jarvis, or the small actual or potential cautery, or Mackenzie's paste.

That electricity will be the means of providing the light of the future there cannot be much doubt in the mind of any one who has visited the recent (1884) Electrical Exhibition under the auspices of the Franklin Institute of Philadelphia. What is wanted by the physician is a simple, economical, and easily-managed battery, as in Fig. 109.

DIRECTIONS FOR CARBON CELL BATTERY. HOW TO MAKE THE BATTERY FLUID.

To 20 fluidounces of tepid water add 4 ounces of *pulverized* bichromate of potassium. Stir the mixture until the water has taken up all that it will of the bichromate (a portion will remain undissolved). Now add—a little at a time, and at intervals to prevent heating the solution—9 fluidounces of sulphuric acid. This will make two pints of fluid,—a little more than enough for once charging four cells. The solution should be made in either a glass, stone, or porcelain-lined vessel.

Fig. 109.—The Carbon Cell Battery.



HOW TO CHARGE THE BATTERY AND KEEP IT IN ORDER.

Remove the nuts B, C, D, E, and the screws F, G, H, I, and take off the vulcanite lid. Lift out the carbon cells and pour into each 7 fluidounces of the battery fluid, filling it to within say three-fourths of an inch of the top. Replace the carbon cells; lay on them the rubber packing, and put on the lid; replace loosely the screws and nuts, and tighten them symmetrically (so as to make an equal bearing on the washers), turning them in couples, B and G, C and H, D and I, E and F.

The zincs should be kept clean and well amalgamated, and the inner edge of the metallic rings through which they pass should be kept clean and bright.

When the battery is to be used, place one of the pin connections of the conducting cord in the socket O. If it is desired to use but one cell, place a zinc in cell No. 1, and attach to it the other pin of the conducting cord. If two cells are to be used, place a second zinc in No. 2, and the conducting-cord pin in it, and so on, if three or four cells are to be used, always putting one pin of the cord in O and the other in the zinc in the highest numbered cell which is desired to be included in the circuit.

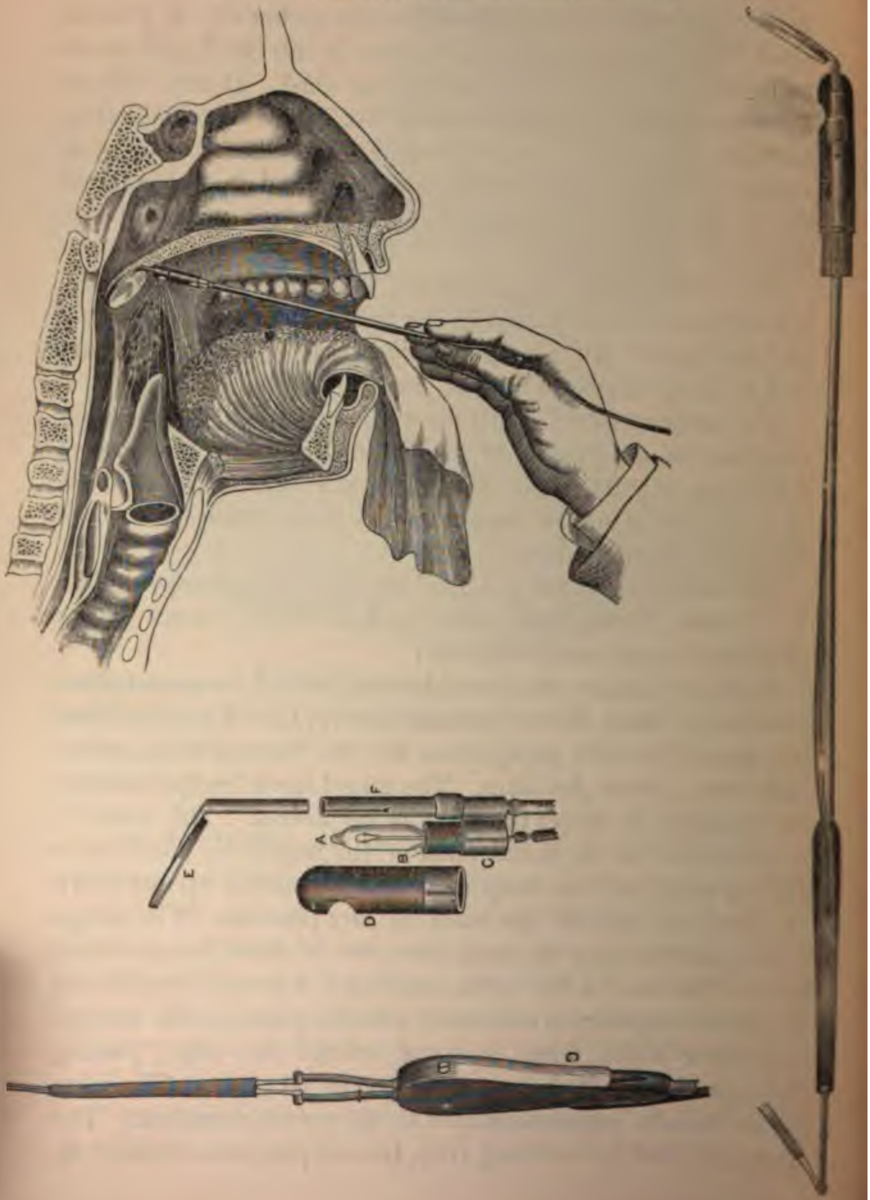
When the battery is not in use the zincs should be taken out of the cells and placed in the rubber cup A. This should be kept nearly full of water, with a teaspoonful of mercury in it to keep the zincs in good condition.

The carbon cells will last for a long time, and when necessary, say once a year, they may be freshened up by allowing a solution of nitric acid and water, say one part acid to six of water, to stand in them for a few hours, with subsequent rinsing in warm water.

The following is the modified electric laryngoscope, of Mr. E. T. Starr, Electrician, which will be found useful by the ophthalmic and aural surgeons:

In this appliance the incandescent lamp A is mounted on a vulcanite base, B, set in metal sleeve, C. A non-conducting guard, D, with an aperture for the transmission of the light-rays, covers the lamp. The guard turns freely, enabling the operator to direct the light as he desires. The sleeve C is connected to the metal stem of the handle by means of a sliding ring, and the lamp may thus be moved up and down or revolved around the stem in any position. The lamp-wires pass through the lamp-base, one of them being wound around the stem a few turns, making it a part of the circuit; the other lamp-wire is connected with the gutta-percha covered conductor which forms a spiral around the stem, passing through the handle to one of the terminal posts. (The stem of the handle communicates with the second terminal.) The mirror is held by a sliding ring, in clamping jaws, formed by splitting the outer end of the handle extension. This method of organization permits the use of different sizes of mirrors.

Fig. 110.—Electric Laryngoscope.



The handle proper is of hard wood, and is provided with a spring, G, which makes and breaks the circuit. In use the handle is held between the thumb and forefinger, the spring being pressed by the second finger to complete the circuit.

The whole apparatus is well made and handsomely finished, all metal parts being nickel-plated.

Its many advantages in examination of the throat will be manifest at once to the experienced aurist and laryngologist.

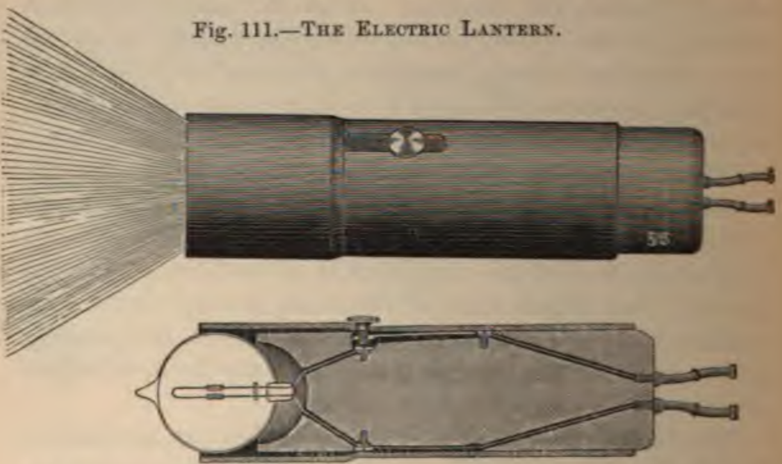
A Storage Battery.—The storage, a very useful form of battery, being a diluted solution of sulphuric acid or a soluble sulphate like sodium, charged with electricity. The boxes contain several thin plates of lead. An electrical current, or, rather, the electrical energy generated through a dynamo, by water-power (or any other power), may be carried into a "storage battery," and then through the agency of a chemical decomposition of the lead, be retained there until required for use as a motive power.

Ultimately a supply will be obtained from public dynamo machines, just as we receive our illuminating gas; but the companies must provide a resistance-coil or coils of wire to regulate the flow of the current so as not to burn up the apparatus. But as this form of electricity is only provided in certain streets and at a much greater cost than illuminating gas, we must for the present, if we desire the light, expect to pay for it.

The electric lantern (Fig. 111) was originally devised by Mr. W. Waters, of New York, for reading astronomical instruments in his observatory. As modified to adapt it to their needs, it will be found very useful by physicians to supply light for operating on dark days, and by the surgeon when a strong light is desirable for the examination of the throat and ear. The light is supplied by an Edison five-candle lamp, run by the six-cell carbon battery. The sectional cut shows very nicely the construction of this useful appliance.

Incandescent electric lamps or electric lanterns of small size for the purposes of the physician cost a moderate sum, but he will find them liable to accident from breakage, etc., especially if used with powerful battery or dynamo machines. We have experimented with the batteries of Grove, Bunsen, the Bichromate, and Leclanche. The objections to Grove's are the fumes from the nitric acid and the cost of platinum, but it will last from five to six hours' continuous use. The Bunsen, with large carbons, can be used with good results. Three or four cells, with quart cups, will answer for a small electric lamp if placed near the operator; if at a greater distance, a larger number of cells will be required to overcome the resistance of the additional wire, the electro-motive force being 1.9 volts. This battery will remain in constant action from five to six hours, but it is found to be troublesome because of its slopping. The Bichromate is a single fluid cell, consisting of a zinc plate, between two carbon plates immersed in a saturated solution of bichromate of potash in water, to which is added very slowly fifteen per cent. of sulphuric acid. Even a large-sized bichromate cell will only last about two hours' continuous use; but by lifting out the zinc, or by filling the cells with pure water, when the battery is not in use, it will last much longer for the small electric lamps.

Fig. 111.—The Electric Lantern.



If this battery is employed for the galvano-cautery it is best to use twelve large plates,—four of zinc and eight of carbon. The exciting fluid consists of ten per cent. solution of bichromate of potash, to which the same proportion of sulphuric acid is added. The Leclanche's battery is not to be recommended, owing to the rapidity with which it exhausts itself when its intensity is not sufficient to overcome the resistance.

Incandescent Electric Lamps.—The electric light was first obtained by a galvanic current crossing two cones of carbon placed one in front of the other, but the wear of which was rapid (Davy).

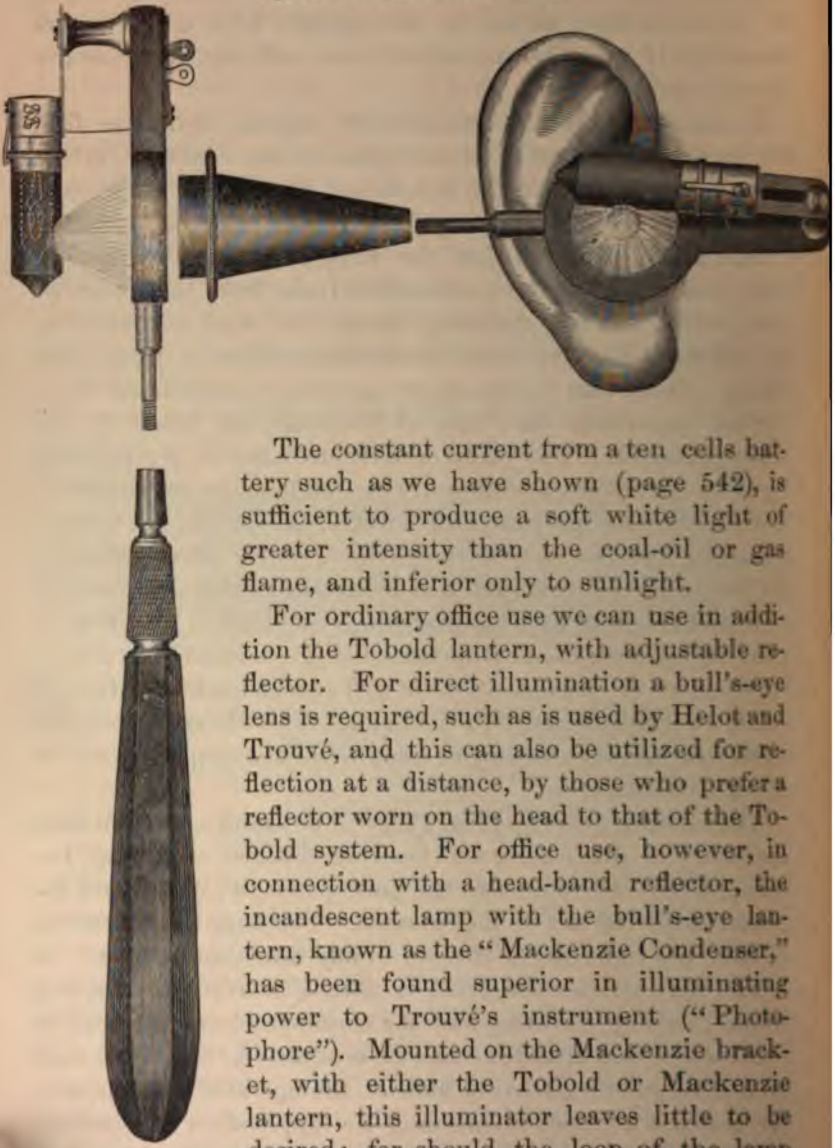
But Leon Foucault had the happy idea to employ very hard coal, which is less combustible (coke from the retorts of gas-works), and by regulating the limit of their combustion, so as always to have them at the same distance from each other. Since that period there have been constructed more perfect regulators than that of Foucault, but based on the same principle. The preference in medicine is given to the light by means of a platinum wire reddened or whitened by the pile, as the polyscope of Trouvé, or, better, the photophore of Dr. Helot, constructed by Trouvé, composed of a "Changy lamp" enclosed in a cylindrical tube, the free end of which is shut by a second tube, in which is mounted a converging lens, the end opposite being provided with a concave reflector. Examinations at will can be made by a frontal band, or it may be held in the hand. The electric luminous focus can be independent, or fixed to a rhinoscopic mirror or electric otoscope.

The electric otoscope (Fig. 112) will be found a very efficient appliance in diagnosing and treating diseases of the ear, because, while it illuminates the parts perfectly, it does not interfere with the use of instruments. The lamp is adjustable, so that the light can be thrown in any direction desired.

The hard-rubber speculum is placed in a non-conducting frame carrying the lamp and the conductors, and a handle is provided so that after the otoscope is adjusted, the patient may hold it in position, leaving both of the operator's hands free for the use of instruments and the application of medicaments. The conducting cords are coupled to the posts and the small end of the speculum inserted in the ear.

The electric otoscope can also be used as an illuminator for the nares, for which purpose it requires a larger speculum.

Fig. 112.—Electric Otoscope.

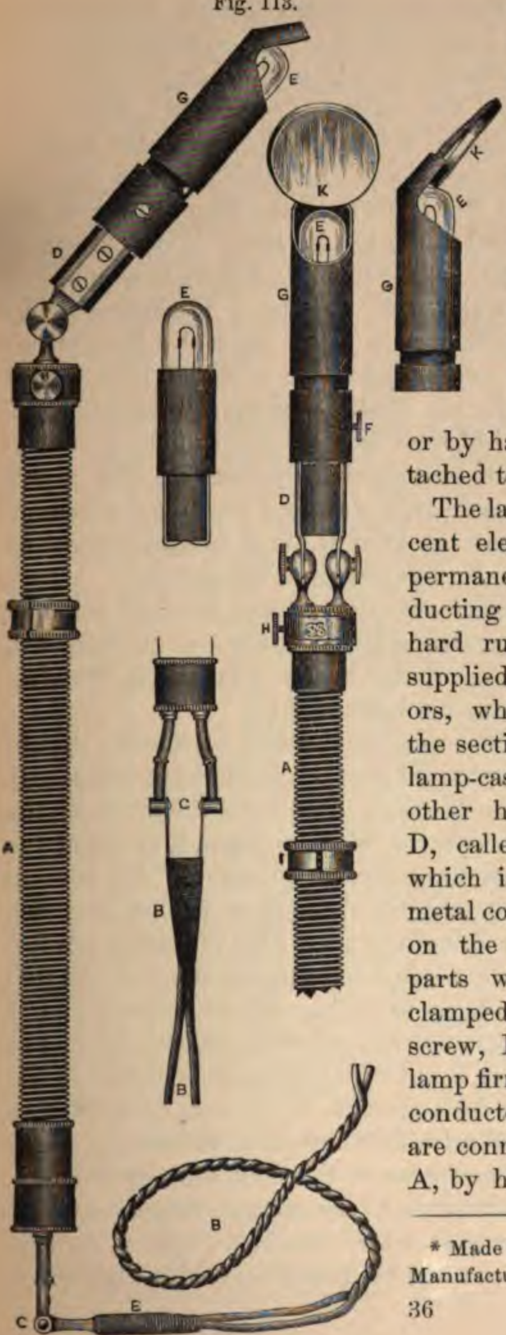


The constant current from a ten cells battery such as we have shown (page 542), is sufficient to produce a soft white light of greater intensity than the coal-oil or gas flame, and inferior only to sunlight.

For ordinary office use we can use in addition the Tobold lantern, with adjustable reflector. For direct illumination a bull's-eye lens is required, such as is used by Helot and Trouvé, and this can also be utilized for reflection at a distance, by those who prefer a reflector worn on the head to that of the Tobold system. For office use, however, in connection with a head-band reflector, the incandescent lamp with the bull's-eye lantern, known as the "Mackenzie Condenser," has been found superior in illuminating power to Trouvé's instrument ("Photophore"). Mounted on the Mackenzie bracket, with either the Tobold or Mackenzie lantern, this illuminator leaves little to be desired; for should the loop of the lamp burn off, or the battery give out, we can turn on the gas.

The most satisfactory incandescent electric light (see Fig. 113) with which I have experimented is that of Mr. E. T.

Fig. 113.



Starr,* known as the electric mouth-lamp, or for the ear as the electric otoscope.

This lamp illuminates the aural and oral cavity with great brilliancy. It is as yet employed as a direct light by holding it in the hand like a candle with a speculum in the ear, or by having the mirror attached to a head-band.

The lamp, E, is an incandescent electric light, mounted permanently in a non-conducting case or cylinder of hard rubber. The lamp is supplied with metal conductors, which pass outside of the section of the case. The lamp-case is carried in another hard-rubber cylinder, D, called the lamp-holder, which is also supplied with metal conductors fitting those on the lamp-case, the two parts when adjusted being clamped together by the set-screw, F, thus holding the lamp firmly in its socket. The conductors of the lamp-holder are connected to the handle, A, by hinged joints, so that almost any desired adjustment is readily secured. This handle is called a resistance handle, because it is wrapped with wire of a low conducting power, by which, through the agency of the ring, I, the flow of the current is regulated. When the ring is placed at the end of the handle nearest to the battery-cord, the resistance is reduced to the minimum and the current from the battery flows freely to the lamp. Sliding the ring to the opposite end of the handle, compels the current to travel through the wire with which the handle is wrapped to the ring and back again, thus forming a resistance. The connection to the battery-cord, B, is made by the spring-coupling, C. A non-conducting guard or shield, G, is placed over the lamp-globe for the double purpose of preventing the radiation of heat and of directing the light to any point desired. At H is a screw for breaking the circuit. The circuit should be broken occasionally during a prolonged examination, and also whenever the lamp is not in use, to prevent its becoming so hot as to be unbearable in the mouth.

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* Made by the S. S. White Dental Manufacturing Company.

For the examination of posterior cavities, a mirror set at an angle of forty-five degrees is attached to the end of the guard. With some modifications of the mirror attachment, the electric mouth-lamp will form a laryngoscope.

This lamp in the hand was found useful to examine the anterior surfaces of the pharynx and the Eustachian tubes. By placing it inside of the mouth, it illuminates the cavity of the nose, sides of the cheeks, the teeth, and gums, showing the outline of the bones and any foreign substance. To develop its full capacity it only requires about 3½ to 5 volts, or a current of three cells of a Bunsen battery. One very great advantage of this incandescent electric light is, that it is so small that it passes into the nose, or external auditory meatus, and is mounted permanently in a non-conducting case or cylinder of hard rubber. In using it as a laryngoscope it is dipped in ice-water, or connected with a syringe, which can be filled with water; it can then be introduced into, and placed in contact with, the throat or other parts of the body without burning. There are yet some defects in all these instruments for laryngoscopic and aural surgery which Mr. E. T. Starr is endeavoring to modify so as to make them more available in practice.

Dr. Carl Seiler* exhibited his electric laryngoscope before the Pennsylvania State Medical Society, May 16, 1884. It consists of the ordinary concave head-mirror, with a bar attached to its lower edge. The incandescent lamp is placed on this bar; between the lamp and the mirror is placed a strong convex lens, while between the lamp and the patient there is a mica shield.

The objection to all instruments employing an incandescent platinum wire, is that to obtain sufficient light the heat generated is so great as to fuse the wire. In Bruck's instrument its size debarred its employment except for oral examination; Nitze's instruments were too large for practical use; in Leiter's instruments the two essential water-pipes made them too bulky; in Adams's laryngoscope the light was apparently too poor. Trouvé's frontal photophore is a very serviceable instrument. Dr. Seiler's instrument is practically but the photophore placed in front of the head-mirror; its disadvantage is its weight. The disadvantages of the Starr instrument are the slight heat occasioned, and the fact that the eye of the observer is not thoroughly protected from the light.

Up to the present time, the incandescent light has apparently not been employed for the examination of the eye. Dr. Seiler, speaking of his electric laryngoscope, writes that "it may be used for the examination of the eye," but does not appear to have so employed it. Dr. L. J. Lautenbach,† of Philadelphia, has been using the electric light for this purpose. Since October of 1884 he has employed the incandescent lamp in the ordinary situation of the gas-stand, also within a Tobold condenser, as well as attached directly to the ophthalmoscope, employing the light with plane and concave mirrors, the latter of from three to fifteen inches focal distance. The method which has been of the most service where small lights only could be employed is that shown in Fig. 114.

DR. LAUTENBACH'S ELECTRIC OPHTHALMOSCOPE.

The instrument is figured on p. 552. Fig. (1) is three-fourths natural size, (2) being the exact size of the lamp.

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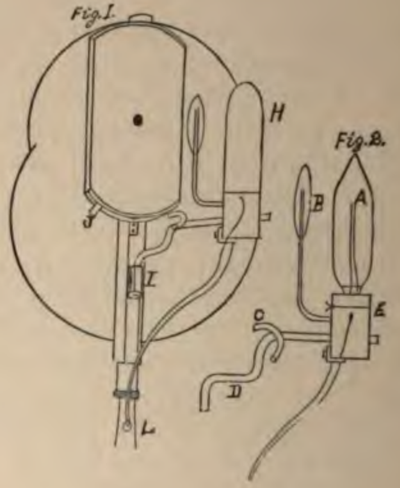
* Transactions Medical Society of Pennsylvania, vol. xvi., 1884, p. 349.

† Medical and Surgical Reporter, vol. li., March 7, 1885, p. 297.

It consists of an ordinary Hunter's Loring swinging mirror ophthalmoscope, to which is soldered the slot I; fitting into this slot is the arm D, which carries upon it a hard rubber cylinder, E, which can be slid down closer to the mirror if desirable; this rubber cylinder carries upon its upper extremity the incandescent lamp A, over which is fitted the asbestos (non-conductor of heat) cap H, between which and the posterior surface of the lamp is the reflector. Fitting into the rubber base, E, is a wire carrying the biconvex lens, B, of three-fourths of an inch focus. The lens can be approached to the light at will. It should, however, be placed at about half an inch from the filament. On the bar D is a cross-bar, C, the ends of which strike against the projections of the swinging mirror J. This bar is of such length on either side as to place the lamp at an angle of 60°, with the general plane of the mirror; by this device the swinging mirror is placed in position for one or the other eye, by adjusting the lamp for the same eye. The wires are carried from the hard-rubber piece either down to an opening, L, entering a hollow fixed handle, or to a ring which slides easily about the lower end of the handle; this latter device allows of the ready de-

Fig. 114.



tachment of the handle. Two asbestos caps are employed: in one the light makes its exit through a small round opening; in the other, which is only used occasionally, the opening is a vertical slit. The convex lens concentrates the light and renders it almost parallel. The plane-reflecting surface in connection with this lamp has been used, but has not been found as satisfactory. A concave reflector, with a focal distance of three inches, was without benefit. If the amount of light obtained in the eye is more than the observer desires, it is only necessary to revolve the lens B out of the field of light.

* * * * * * * *

This light will prove of advantage in the examination of the dark complexioned; whenever there is a small pupil; of myopes,—in all these cases giving us better illumination than we can obtain by other means. It will be of service in atrophic nerve cases, but its advantages are particularly marked in slight retinal inflammations, and for the study of the retinal circulation. Because of its intensity, it will allow us to make more thorough ophthalmoscopic examinations in cases of corneal, lens, and vitreous opacities.

THE ADVANTAGES OF THE ELECTRIC LIGHT.

Considering the advantages of the electric light, we have, first and foremost, its approach to daylight,—its whiteness. In all other artificial lights, with the exception of the calcium light, the yellow rays preponderate. Yellow rays are a decided disadvantage. So apparent was this to William R. Wilde* that in his treatise on ear disease, he writes, "Shades of vascularity produced by inflammation or congestion, speckled opacities, minute points of morbid deposit, and slight ulcerated abrasions, want of polish, and loss of transparency, etc., cannot be detected" by the artificial light. In the white light of the incandescent filament there are no yellow rays, and the illumination resembles very strongly a good daylight. Of course, if the current traversing the filament be not of sufficient intensity, we may have yellow light. A second advantage is its brilliancy or intensity. This brilliancy is so intense as to allow us the more readily to recognize slight changes; this is marked in ear examinations. By means of this light the rhinoscopic image becomes very much more distinct, and the membrana tympani shows slight changes not otherwise discernible.

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* Diseases of the Ear, 1853, p. 69.

There are two advantages possessed by this light which are often considered objectionable. I refer to the fact of the light casting strong shadows, and the presence of the image of the filament in the part illuminated. Having above set forth why I consider them as aids in examination, it is not necessary to say more.

The vitiation of the air by gas is a material objection, which is particularly noticeable in the dark-rooms of our eye dispensaries. The electric light would render the dark-room more bearable, and the headache, so frequently occasioned, would be much less common.

For the larynx and posterior nares, Mr. Starr's or Dr. Seiler's laryngoscope, or Trouvé's photophore, or the lights placed in a Mackenzie or Tobold condenser, can be employed.

The illumination of the ear is best attained by means of an electric lamp placed close to the speculum, the lamp enclosed in a shield or cap, with a small round opening; if a large lamp be at hand, the employment of the head-mirror to reflect the direct rays into the ear as in Figs. 112 and 113.

Drs. Dennett* and Juler† have each of them produced new electric ophthalmoscopes. In these instruments the lamp is fixed on the handle of the instrument. As reflectors they use small mirrors placed at an angle of forty-five degrees to the vertical and horizontal planes of the instrument. Dennett, by means of convex and concave lenses, renders the rays of light parallel before falling on the plane mirror. Juler allows the divergent rays to fall directly upon a concave mirror. Both instruments labor under the disadvantage of using the light after it has passed through the irregularly refracting top of the incandescent lamp.

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* N. Y. Med. Rec., vol. xxvii., 1885, p. 503.

† Brit. Med. Jour., 1886, p. 305.

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